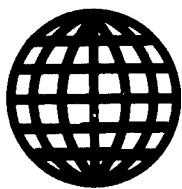


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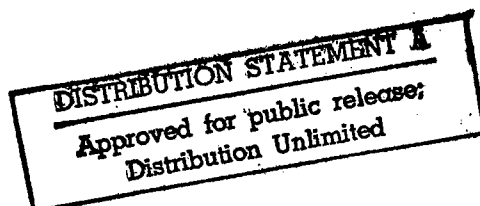


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Science & Technology

CHINA: Energy



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China: Energy

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Outlook Said Good For Energy Production In 1992, 1993

926B0079D Shanghai JIEFANG RIBAO in Chinese
2 Apr 92 p 5

[Article by Huang Xing [7806 5281]: "State Information Center Offers Optimistic Forecasts For Energy Resource Production in 1992 and 1993, Coal Prices Will Rise Again, Electric Power Will Develop Rather Quickly, Crude Oil Output Will Be Encouraging"]

[Text] Energy resource production in China during 1992 will throw off its situation of stagnation and reach 1,090,250,000 tons, a growth rate of 5.07 percent. Projected total production of energy resources in 1993 will be nearly 1,131,500,000 tons, a growth rate of 3.78 percent. At the same time, the amount of energy resources consumed will also increase, with projected total consumption of energy resources in China reaching 1,050,940,000 tons in 1992 and 1,092,410,000 tons in 1993, for growth rates of 4.20 percent and 3.95 percent, respectively. This is the projected situation for energy resources made by the Economic Forecasting Department in the State Information Center for 1992 and 1993.

These forecasts feel that coal prices will gradually rise back up, with absolute reserves on hand in society and amounts of reserves in coal producing enterprises at the end of 1991 dropping back to normal reserve levels. If coal haulage develops appropriately, the external environment for coal production in 1992 will look better and coal production may grow rather quickly at a growth rate of about 6 percent. There will also be a concurrent increase in coal reserves in society as a whole, which will

cause problems for sustained growth in coal production during 1993. The rate of growth in coal production during 1993 is expected to decline, for a growth rate of 4.43 percent.

Electric power output will grow at a rate of more than 7 percent during 1992 and 1993. This includes a relatively fast rate of growth in thermal power with growth rates of 7.18 percent and 8.82 percent, respectively. Total thermal power output will be 576.726 and 627.597 billion kWh, respectively. Total hydropower output will be 145.458 and 150.213 billion kWh, respectively, for growth rates of 7.94 percent and 3.27 percent, respectively.

There will also be stable growth in crude oil output as a result of major efforts to develop offshore petroleum and the Erlian Oil Field and Dian-Qian [Yunnan-Guizhou] Oil Field in the Chinese interior, with growth rates of 1.28 percent in 1992 and 1.24 percent in 1993. Crude oil output will reach 143.8 million tons in 1993 and there is hope that the 145 million tons index during the Eighth 5-Year Plan can be attained ahead of schedule.

The growth rate of energy resource exports is expected to be sustained at the high level of 6 percent during 1992 and 1993. This will include a reduced rate of growth in exports and total amounts exported for crude oil and finished oil products because of the acute contradiction between supply and demand in China. Growth of coal and coking coal exports will be substantially accelerated. A gradually changing structure of energy resource exports, increased coal exports, and improved quality of energy resource exports will be the main trends.

Speeding Up Hydropower Construction Through Improved Investment Conditions

926B0085A Beijing ZHONGGUO NENGYUAN
[ENERGY OF CHINA] in Chinese No 4, 25 Apr 92
pp 4-7

[Article by Yang Zhirong [2799 1807 2837], Qu Shiyuan [3255 2514 6678], and Yang Min [2799 2404] of the State Planning Commission and Chinese Academy of Sciences Energy Resource Institute: "Improve the Investment Environment, Accelerate Hydropower Construction"]

[Text] For a long time, China has implemented a centralized financial system of unified state control over income and expenditures in which industrial departments turn over their profits to the state financial administration, the state subsidizes operating losses, and investments in capital construction are allocated in a unified way by the state financial administration. Industry and department development depends not on self-accumulation but instead on arrangements made by the central government that are for the most part unrelated to whether or not departments and enterprises have self-development capabilities. With the start of reform of the economic system in the 1980's, major changes occurred in the state's investment system. Investments in capital construction shifted from financial allocations to bank loans, overall economic operational mechanisms shifted toward enterprise responsibility for profits and losses, industry self-accumulation, and rolling development, and the state's investment policies became a key factor determining the existence and development of enterprises.

Although the state has stipulated that the energy resource and electric power industries are to receive key support in the areas of production and capital construction and has called for the formulation of corresponding policies in credit, taxation, prices, and other areas to promote their upgrading and development, they are still far from being readjusted to their proper status at the present time and existing electricity price policies and the financial system have made it impossible for low-priced hydropower to achieve self-accumulation. Hydropower stations under the jurisdiction of power grids implement unified accounting for grids and do not determine the price for electricity supplied to the grids. The amount of power they supply is included in the state's planned allocations and grids set state unified prices for sales of electricity, so there is basically no self-accumulation in hydropower. Original hydropower stations that implement independent accounting and are not under the

jurisdiction of grids sell electricity to grids according to the price for electricity supplied to grids. These power stations were built through state allocations and do not have to repay the principal and interest. The amount of power they supply to grids is included in state unified allocations and the grids continue selling the electricity at prices in the 1976 electricity price list. The price for electricity they supply to grids is also very low, 0.028 yuan per kWh at Danjiangkou, for example, and 0.033 yuan for Sanmen Gorge and 0.0389 yuan for Gezhouba, which is insufficient for forming self-investment channels. With the exception of a small amount of retained profits, all the profits in electric power departments are turned over to the state financial administration in the form of profits and loan repayments. Electric power departments then obtain various types of loans from the state for capital construction, so again there are no operational mechanisms for the direct conversion of profits from electricity sales into capital construction investments. The electric power industry, which continues to be based on low electricity price levels, has seen its profit rate on capital decline every year, dropping from 12 percent in 1980 to the present level of 4 percent, so it lacks both a loan repayment capability and self-development capability. With pressure from demand for electricity, they cannot even consider accelerating the development of hydropower.

To give hydropower as well as thermal power and nuclear power the opportunity for self-development, the most basic thing is of course to readjust the price of electricity upward and reduce taxes and to conduct regulated floating of electricity prices along with power plant construction costs, interest rates on loans, fuel prices, wage levels, changes in market demand, and so on to earn profits for investment in electric power construction. In a situation of difficulties in quickly straightening out prices and the tax system, the investment environment and investment policies should open up routes for accelerating hydropower development.

I. Reduce Interest Rates on Hydropower Loans, Extend the Loan Repayment Period

The state has implemented differential interest rate policies for bank loans for capital construction in 13 industries including energy resources, communication, communications, and some raw materials, as well as for the salt-making industry and agriculture. The differential interest rates are divided into three grades (Table 1) and are floated downward by 30 percent, 20 percent, and 10 percent, respectively, on the basis of the interest rates on normal loans for fixed assets. Hydropower is included along with electric power in grade 2.

Table 1. Table of Differential Interest Rates for Capital Construction Bank Loans

Grade	Item	1 February 1989	2 March 1990, 21 August, 1990
Grade 1	Loans for agriculture (including chemical fertilizer and phosphorous, sulfur, and potassium mining as part of industrial support for agriculture), coal (not including independent accounting coal dressing plants), crude oil extraction, energy conservation measures, harbors, and salt-making.	Float downward 30 percent	
	More than 1 year, up to and including 3 years	9.00	7.56
	More than 3 years, up to and including 5 years	10.08	8.10
	More than 5 years, up to and including 10 years	13.68	8.64
	More than 10 years	Calculated at compound interest for 1-year periods*	8.64
Grade 2	Loans for electric power, communication (not including harbors), railways, posts and telecommunications, civil aviation, vehicle, boat, and aircraft purchases, construction materials, forestry industry and independent mining projects in the iron and steel and non-ferrous metals industries	Float downward 20 percent	
	More than 1 year, up to and including 3 years	10.26	8.64
	More than 3 years, up to and including 5 years	11.52	9.36
	More than 5 years, up to and including 10 years	15.42	9.54
	More than 10 years	Calculated at compound interest for 1-year periods*	9.54
Grade 3	Loans for iron and steel, non-ferrous metals, and chemical industry	Float downward 10 percent	
	More than 1 year, up to and including 3 years	11.52	9.72
	More than 3 years, up to and including 5 years	12.96	10.44
	More than 5 years, up to and including 10 years	17.46	10.80
	More than 10 years	Calculated at compound interest for 1-year periods*	10.80

*Interest rate for 1-year loans is 11.34 percent.

In the division into differential interest rate grades for the "shift from allocations to loans", coal and crude oil extraction, energy conservation measures, and agriculture (including chemical fertilizer, etc.) are included in grade 1 and receive the treatment of a 30 percent downward float compared to interest rates for fixed assets loans. Although hydropower also involves enterprises that produce electric power, they are also enterprises involved in primary energy resource development, so in this point they are completely identical in essence to coal and petroleum extraction and should be placed in grade 1 with them. Hydropower consumes no fuel and has the benefit of replacing coal, so it is a totally energy conservation-type industry. Compared to non-energy conservation-type projects, it should also be placed in grade 1. Hydropower usually has comprehensive benefits like flood prevention, irrigation, and so on, it can increase agricultural output like chemical fertilizers, and it can reduce flood damage. These three characteristics of hydropower give it the full conditions for being moved into grade 1. Instead, it has been included in grade 2 and given treatment of floating downward by 20 percent, which inevitably reduces hydropower's attraction for the direction of social investments and its ability to repay loans. We suggest that it should be readjusted into grade 1.

The state's repayment policy stipulations for capital construction loans require that the loan principal and interest be repaid within a specific time limit. The loan repayment schedule including the construction phase cannot exceed 12 years for large and medium-sized projects and cannot exceed 15 years for especially large projects. This has restricted the development of hydropower base areas and the construction of large and medium-sized hydropower in China and blocked China's path in fully fostering China's huge potential hydropower resources. Large and medium-sized hydropower stations are a focus of China's hydropower development and they usually have construction schedules of about 8 years, while especially large hydropower stations may take up to 15 years, so they basically do not have the capability of repaying loans on schedule. If this is the case and we only develop small-scale and some medium-sized hydropower projects, China's abundant hydropower resources will have to continue waiting for a long time for opportunities and accelerated hydropower construction will be just meaningless talk. The Three Gorges project basically shows that there is no need to debate this point. Borrowing from the successful experiences of the developed nations in preferential development of hydropower, extending the repayment schedule

for hydropower loans to 25 to 30 years and providing a broad 5 to 8 year schedule is more appropriate. Or, there would be no harm in adopting policies to permit successive borrowing and using this to repay old loans to open up a route for the existence and development of hydropower.

II. The State Should Provide Appropriate Subsidies to Comprehensive Utilization Hydropower Projects

While implementing a financial system for central unified state control over income and expenditures, the amount of the investment required for hydropower stations with comprehensive utilization benefits actually serves only as textual research for program selection. Investment shares for a few hydropower stations in fact also come from one source and are turned into accounts for allocation in financial operations. As soon as a hydropower station is completed, it no longer has true responsibility for management results and does not assume responsibility for the duty of repaying the investment. Things are quite different following the "shift from allocations to loans". Facing a system of implementing compensated utilization of capital, raising their own capital, and being responsible for their own profits and losses, they have to give careful consideration to the effectiveness of investments and loan repayment possibilities. Otherwise, they will have no sources for borrowing loans or fall deeply into debt.

All water consuming departments established on the foundation of multiple systems of ownership of the means of production and multiple systems of capital allocation often find it difficult to take advantage because of conflicting departmental interests and the amount of capital shares and find it difficult to form an operationally flexible and effective consultation and public discussion organization, and so on. This makes true implementation of all capital shares difficult, and the adoption of administrative measures in this area will not be effective for long periods.

A successful experience in several countries has been to adopt a policy of having departments with significant comprehensive utilization objectives assume responsibility for borrowing and repaying loans for a corresponding portion of the investment and having the state provide appropriate subsidies for the investments that should be the responsibility of indistinct targets. The state can reduce investments in other substitute projects like flood prevention, irrigation, water-borne shipping, water supplies, timber floating, and so on and increase taxes on comprehensive utilization benefits to compensate for this portion of the investment. The best method is to establish a central hydropower development fund and use 10 to 30 percent of the investment in comprehensive utilization hydropower stations to support hydropower in the form of uncompensated or low-interest loans to reduce some of the pressures for borrowing and loan repayment for hydropower projects. The operating mechanisms are relatively simple. This would seem to be a policy that we could adopt at the

present time. Doing things in this way would serve the state, benefit the people, create wealth for our descendants, and not damage benefits.

III. Open Up Capital Channels, Establish a "Central Hydropower Development Fund"

A prerequisite for self-development is the presence of available capital on a substantial scale. The current electricity price policies and finance and taxation systems do not provide hydropower with the conditions for capital accumulation and rolling development. This is also a direct cause for China's continuing difficulties in moving hydropower development from a difficult situation at the present time.

Before reform of the economic system, the central government was the main factor in investments in the electric power industry, including hydropower. Although a policy of "raising capital through a variety of channels to develop electric power" was implemented following reform of the economic system, the relatively high interest rates on loans in conjunction with the rather long construction schedules for hydropower and the slowness in producing results meant that local areas, industries, and enterprises invested very little in hydropower, and there was no fundamental change in the situation of hydropower relying mainly on state investments for construction. State investments accounted for more than two-thirds of total investments in hydropower in 1990 and one-third of the state's total investments in electric power went for hydropower construction, basically maintaining the original long-term average levels. After shifting from financial allocations to bank loans for capital construction investments and implementing "separation of income and expenditures, contractual responsibility by levels" ("dividing up the stoves to eat") by central and local financial administrations, along with continual intensification of reform of the economic system, the financial strengths of centralized allocations controlled by central authorities have been continually weakened and investments in the state's budget have now been reduced to 20 percent. With a constraint of guaranteeing a specific rate of growth in electric power, there has been a significant decline in hydropower as a proportion of total investments in electric power, from 33.4 percent in 1980 to 17.7 percent in 1990. The proportion of hydropower capacity placed into operation has also declined from 42 percent in 1980 to 13 percent in 1990 (Figure 1). Reliance mainly on limited growth in investments by central authorities cannot reverse the situation of a slow pace of hydropower construction.

A situation of a tripartite balance of forces comprising the state, local areas, and the Huaneng Company for capital to develop electric power has now taken shape. In

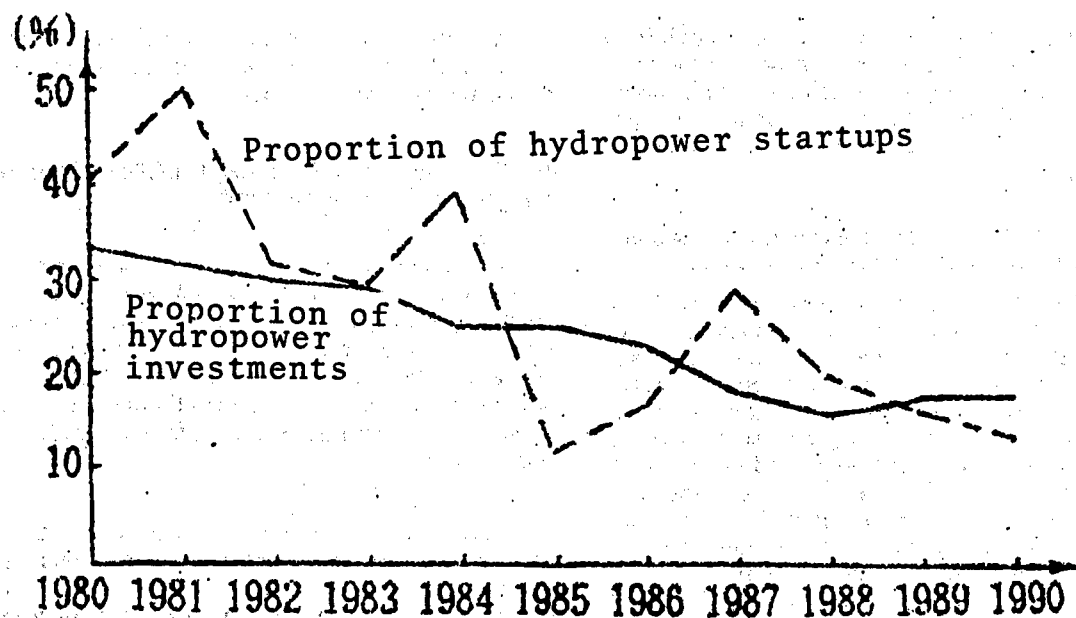


Figure 1. Proportions of Hydropower Investments and Startups

the structure of total investments in electric power in 1990, the state accounted for 35 percent, local areas for 38 percent, the Huaneng Company and conversion from oil to coal for 23 percent, and others for 4 percent, so one can see that as local financial incomes have increased, local areas have now become a powerful primary force in investments. Still, the objective of local areas in investing in power is to solve power shortages as quickly as possible, so there is very little concern for the overall situation, and the capital raised by local areas is mainly invested in thermal power. The Huaneng Company is a key force in electric power investments but its capital is also invested in thermal power. There is not a single hydropower station among the 40 power plants with a total scale of 12,110MW that it has built so far, its investments in hydropower projects in 1990 accounted for just 1.3 percent of its investments in developing electric power, and there are no indications that it is shifting its investment direction toward hydropower.

The state has stipulated that 0.02 yuan will be requisitioned from all enterprises for each kWh of electricity consumed from January 1985 to December 1995 to serve as a special fund for local capital construction of electric power to solve China's severe power shortage and the problem of insufficient capital for electric power construction. The present situation is that more than 5 billion yuan is actually collected excluding reductions and exemptions from collection, and this undoubtedly will play a major role in promoting local development of electric power. However:

1. This special fund is collected at the terminal electricity user and the capital collected is included in local revenues and not turned over to power generation administrative departments or power generation enterprises.

Provinces in the western part of the interior of China that have abundant hydropower resources use less electricity than coastal areas of eastern China so the amounts they collect are limited. Added to the scattering of capital in local areas and the failure of sufficient numbers of capital channels to take shape, they basically are unable to develop local hydropower. In addition, hydropower stations with a substantial scale usually do not supply electricity only to their own region but also supply large amounts of electricity to outside areas, so they cannot collect these special funds, which has exacerbated their difficulties in developing local hydropower.

2. The provinces of eastern China, which have severe power shortages but relatively strong capital forces, are most concerned about guarantees of sufficient electricity supplies and are unwilling to make strategic investments to develop hydropower in western China. Nearly all of the local power construction capital they collect is used to arrange for construction of local thermal power to alleviate their extremely urgent power shortages and they feel that it would be extremely hard for them to think of mobilizing their capital for joint development of hydropower base areas in western China.

The strategic orientation of China's hydropower development is inevitably to give primacy to developing large and medium-sized hydropower stations on the Huang He, Chang Jiang, and middle and lower reaches of the Zhu Jiang, including the huge Three Gorges Key Facility, which have relatively superior technical and economic conditions. Without unified planning by the state and centralized allocation of capital strengths on a substantial scale, and relying only on western China to

raise capital to develop power, it will be impossible to foster China's hydropower advantages and accelerate hydropower construction.

In a situation in which we have still not completely straightened out electricity prices and have not established operational mechanisms for the direct conversion of hydropower profits into investments, a more realistic transitional policy is to borrow from the method of collecting special local electric power construction funds, which covertly raise prices and do not produce a large psychological shock, by temporarily collecting 0.01 to 0.02 yuan per kWh of electricity used and adding the state's investment subsidies for large and medium-sized comprehensive utilization hydropower stations to establish a "Central Hydropower Development Fund" to serve as the main investment force for developing hydropower in western China and adopting an uncompensated or low-interest loan arrangement in conjunction with the corresponding operational mechanisms. Only then can we create the conditions for rolling development of hydropower, give hydropower the vitality for self-development, gradually reverse the long-term situation of slow hydropower construction, and smoothly complete the electric power development objectives stipulated in the 10-year program outline.

Principles and policies are derived from an understanding of the nature of things and are the products of man. Principles and policies that conform to the objective development laws of things will promote the normal development of things. Otherwise, we will bungle an historic opportunity and slow the pace of advance of things. Policies are principles made concrete. There must be a relatively stable policy but there are no policies that do not change. Policies that are continually perfected during practice are often more favorable to adherence to principles. Adherence to principles and implementation of policies must be matched up with the corresponding effective operational mechanisms before they can be implemented properly and produce results.

Ministry of Energy Approves Xiaowan Feasibility Report

926B0088A Kunming YUNNAN RIBAO in Chinese
29 Apr 92 p 1

[Article by Liu Zuwu [0491 4371 2976]: "Xiaowan Hydropower Station Feasibility Report Passes Examination, A Key Project To Develop Hydropower on the Lancang Jiang"]

[Text] The feasibility research report for Xiaowan Hydropower Station, a key project to develop hydropower on the Lancang Jiang, passed an inspection jointly directed by the Ministry of Energy Resources and Yunnan Provincial People's Government on 28 April 1992 in Kunming. Yunnan Province vice governor Li Shuji [2621 2885 1015] stated that this indicates the opening of the curtain on a new high tide in development of hydropower on the Lancang Jiang and the start of

implementation of the strategic policy of transmitting electricity from west to east China.

Xiaowan Hydropower Station is a major construction project that the state has included in the Ninth 5-Year Plan program as well as the first project to be built via a joint investment by the Ministry of Energy Resources, State Energy Resource Investment Company, and the Guangdong Province and Yunnan Province People's Governments on the Lancang Jiang. It will involve a huge investment scale and high technical requirements, among the most technically difficult in the world. These aspects will include: a 284.5 meter high concrete dual-arch dam, the first in the world, a single generating unit capacity of 700MW, unprecedented in China, and an installed generating capacity of 4,200MW, the leader of planned projects in China. After it is completed, it may double guarantee output from the two downstream power stations at Manwan and Dazhaoshan. The Kunming Survey and Design Academy of the Ministry of Energy Resources and Ministry of Water Resources, which was responsible for the feasibility study for Xiaowan Hydropower Station, has done a great deal of survey, design, and scientific research work over the past 10-plus years, overcome several technical problems, and made significant achievements. Nearly 100 experts from throughout China gave it a strict inspection and felt that the feasibility report basically has solid data and a relatively complete program, and rather complete special topic debate and experimental results, and that its content and depth have met requirements.

After the feasibility research report passed inspection, Xiaowan Hydropower Station entered the preliminary design stage and it is expected that the preliminary design will be completed in 1995 and that it will be included among projects for construction during the Ninth 5-Year Plan.

Ministry of Energy Resources senior hydropower engineer Pan Jiazheng [3382 1367 6927] and Ministry of Energy Resources and Ministry of Water Resources Central Planning and Design Academy president Zhu Erming [2612 1422 2494] directed the meeting. Former Ministry of Water Resources and Electric Power vice minister Li Eding [2621 7725 7844] and Yunnan Provincial vice governor Niu Shaoyao [3662 4801 1031] attended the meeting.

Hongshui He Hydropower Project Approved

40100052A Beijing CHINA DAILY (Economics and Business) in English 1 Jun 92 p 2

[Article by Huang Xiang, staff reporter: "Hongshui He Hydropower Project Approved"]

[Text] The government has given its stamp of approval for the first in a series of 10 hydropower stations on the Hongshui River in Southwest China, an official with the State Energy Investment Corporation said yesterday.

Written approval from the State Planning Commission for the launching of the Longtan Hydropower Station—costing 9-billion-yuan (\$1.64 billion)—has been obtained, the official said.

Experts say the Longtan Hydropower Station will play an important role in promoting economic development in the Southwest area, which is still one of the poorest areas of the country.

The Hongshui River is potentially one of the richest areas for hydropower development in the country, the official noted.

The project, located in Guangxi Zhuang Autonomous Region, is designed to have a capacity of 4.2 million kilowatts after the first phase of construction and will be installed with seven 600,000-kilowatt generators.

The project, to be paid for jointly by the State Energy Investment Corporation and Guangxi, Guizhou, and Guangdong, will also use foreign funds to purchase electricity generating facilities and machinery for construction.

A plan has also been made to launch the second phase of construction when the first phase is completed in order to further increase its capacity to 5.4 million kilowatts.

When completed, the reservoir of the power station will be able to store 16.2-27.3 billion cubic metres of water, which can reduce disasters caused by floods in the lower reaches of the Hongshui River and help protect 6,666 hectares of farmland from floods each year.

In the meantime, the dam is also expected to improve navigation and help the Southwest to transport its goods to other places of the country.

The power station will be able to generate 15.6 billion to 18.7 billion kilowatt-hours of electricity annually when in full operation, the official said.

Wu Jiang Development Plans

Corporation Formed to Boost Development

40100061A Beijing CHINA DAILY (Economics and Business) in English 8 Jun 92 p 2

[Text] Guiyang (Xinhua)—The Guizhou Wu Jiang River Hydropower Development Corporation was formed recently in Southwest China's Guizhou Province in order to accelerate development of the hydropower resources of the Wu Jiang River and other natural resources.

The corporation plans to develop the hydropower resources along the river by introducing foreign capital and issuing stocks. In the past, the State investment was the sole funding source for hydropower development.

The plan calls for the corporation to eventually become a large-scale conglomerate consisting of enterprises to produce aluminum, phosphorus and power.

According to General Manager Ye Yinchun, the corporation is currently operating the Wujiangdu power plant, which has a generating capacity of 630,000 kilowatts. In addition, the Dongfeng power station, with a generating capacity of 510,000 kilowatts, is currently under construction.

The development plan calls for the corporation to complete construction and expansion projects on nine power stations located along the river in Guizhou Province. The projects involve power stations in Puding, Yingzidu, Hongjiadu, Dongfeng, Suofengying, Wujiangdukuoji, Goupitan, Silin, and Shatuo. When completed, the system will create a large hydropower base with a generating capacity of 6.4 million kilowatts.

The corporation also plans to build power stations in Hongjiadu and Goupitan in the near future. Construction of the Hongjiadu power station, which will have a generating capacity of 540,000 kilowatts, is expected to begin in 1993, and preliminary work is currently underway at the Goupitan power station, which will have a generating capacity of 2 million kilowatts.

State Energy Investment Corp. Joins Plan

40100061B Beijing CHINA DAILY (Economics and Business) in English 16 Jun 92 p 2

[Article by staff reporter Huang Xiang]

[Text] China's leading State energy investor has joined forces with local financiers to build a series of hydroelectric power projects on the Wu Jiang River, an important tributary of the Yangtze River.

The river, renowned for its rich hydroelectric potential, is 1,037 kilometers long and [its basin] covers 88,000 square kilometers on the upper reaches of the Yangtze.

Plans include the construction of 11 hydropower stations, including two already under construction. Total designed generating capacity is 8.67 million kilowatts, according to the State Energy Investment Corporation.

The corporation, representing the government, has recently launched a joint company with Guizhou Province specifically for this purpose.

The Wu Jiang Hydropower Development Company is the largest of its kind in China. It will be responsible for the general development of the river, including design, construction and management of all power stations.

Corporation officials said the projects represent 41.8 billion kilowatt hours of electricity annually. That will boost electricity supplies across all of Southwest China, abundant in industrial raw materials but lacking electric power to develop them.

Meanwhile the government has recently given the go-ahead for the first in a series of 10 hydropower stations on the Hongshui River in the neighboring Guangxi Zhuang Autonomous Region.

The corporation said it has obtained written approval from the State Planning Commission for the launching of the Longtan Hydropower Station—costing 9 billion yuan (\$1.64 billion).

The project is designed to have a capacity of 4.2 million kilowatts after the first phase of construction and will be installed with seven 600,000-kilowatt generators.

Tianhuangping Pumped-Storage Power Station To Be Built

926B0092 Beijing RENMIN RIBAO (Overseas Edition) in Chinese 14 Apr 92 p 3

[Text] The Tianhuangping pumped-storage hydroelectric power station will be the first large-scale pumped-storage hydroelectric power station in the East China power grid. The station, a joint investment by the National Energy Investment Company, Shanghai city and Jiangsu, Zhejiang and Anhui provinces, has an installed capacity of 1.8 million kW and an annual power output of close to 3.16 billion kWh. The main construction will begin in the second half of 1993 and the first unit will go into operation in September 1997.

Work Begins on 4200MW Jiaxing Plant

92P60318 Shanghai JIEFANG RIBAO in Chinese
17 May 92 p 3

[Excerpt] A few days ago, heavy machinery of the Shanghai Baozhi Special Company began to dump rock along the north coast of Hangzhou Bay, marking the beginning of the construction of the Jiaxing power plant, the largest thermal power project in the country.

Located in Pinghu County, Zhejiang Province, Jiaxing, a key state construction project, will have an installed capacity of 4200MW. The first stage of construction, involving the installation of two 300MW coal-fired units manufactured with foreign technology, is scheduled to go into operation by National Day, 1994. Additional 600MW units will be installed later. After all units are operational, the plant will generate more than 20 billion kilowatt-hours of electricity a year. [passage omitted]

On Correctly Understanding and Managing China's Coal Resources

926B0082 Beijing ZHONGGUO DIZHI [CHINA GEOLOGY] in Chinese No 4, 13 Apr 92 pp 1-2

[Article by Han Ying [7281 5391], assistant general manager of the China Unified Distribution Coal Mine Corporation: "Correctly Understanding and Properly Managing China's Coal Resources"]

[Text] Since the 3d Plenum of the 11th CPC Central Committee, China's coal industry has developed substantially, with raw coal output in China rising from 620 million tons in 1978 to 1.08 billion tons in 1990, an average yearly increase of 38 million tons, the greatest growth and longest period of sustained growth since the nation was founded. Within China's raw coal output, output was 480 million tons from the state's unified distribution coal mines, 205 million tons from local state-run coal mines, and nearly 400 million tons from collective and individual coal mines run by townships and towns and all types of joint venture coal mines.

The state's Eighth 5-Year Plan and 10-Year Program call for coal output in China to reach 1.23 billion tons in 1995, with unified distribution coal mines accounting for 550 million tons, and 1.4 billion tons in the year 2000, with unified distribution and local coal mines each accounting for one-half. Looking at the present situation both for unified distribution coal mines and local coal mines, the tasks involved in attaining this planned objective are both very arduous.

Coal is China's most important primary energy resource. Coal now accounts for 76 percent of primary energy resource consumption in our national economy. Moreover, there will be no fundamental changes in the situation of coal accounting for more than 70 percent for the next several decades into the future. There will be continually growing demand for coal by our national economy. Our average annual thermal power installed generating capacity in the future will be 9,000MW, which will consume at least 20 million tons of coal. Added to the demand for coal by the metallurgical, chemical, construction materials, and other industries, if we do not make major breakthroughs in energy resource conservation, we will be forced to make average yearly increases of 30 to 40 million tons over the next 10 years. Thus, shortages in the relationship between coal supply and demand will be the overall trend in the future, so we must gain an understanding of this as soon as possible.

The coal industry is an industry centered on extraction of coal resources, so the resource question is the main issue in coal industry development as well as an extremely important issue affecting China's modernization and construction.

The prominent things in coal resources are the extent to which resource evaluation, resource utilization, resource management, and resource reserves can guarantee development. While fully understanding the magnificent

achievements we have made in this area over the past 40-plus years, we should also note that we still have many problems that require conscientious solution.

How should we correctly understand China's coal resource situation? It is certainly a fact that China has abundant coal resources. Total resource reserves in China announced in 1981 were 5 trillion tons, putting China in third place in the world in total resources, only behind the Soviet Union and the United States. However, if we factor in China's large population, the amount available per capita is just 5,000 tons, which is lower than the average amount available per capita in the world. Moreover, more than 4 trillion tons of our 5 trillion tons are projected reserves, not proven reserves. Thus, it should be said that we have not gained a grasp over most of our coal resources. China had more than 950 billion tons of available reserves at the end of 1990, about 20 percent of which have already been utilized. While we do have substantial non-utilized reserves, we have only 95 billion tons of carefully surveyed reserves, equal to 10 percent, so we have very limited carefully surveyed reserves that can be used to build mines. Analysis of the regional distribution shows that China's coal resources are extremely unevenly distributed. The economically developed east China region which has great demand for coal contains just 11 percent of our total reserves and the extraction conditions there are becoming increasingly complex. Moreover, west China, which has 89 percent of our reserves, is distant from energy resource consumption centers and restriction by water resources and transportation conditions make large-scale development of coal very difficult. Looking at the mix of our coal varieties, China's coal resources contain much power coal and little coking coal. Most of the [refined] coking coal is gas coal while only a very small proportion is rich coal, coking coal, and lean coal. If we fail to adopt protective extraction measures for these rare coal varieties, we may experience severe shortages of coking coal resources in the future. In another area, compared to the main coal producing countries, China's coal seam preservation conditions are relatively poor and the geological structures are complex, so only limited amounts of our resources are suitable for open-cut mining and both development and excavation are rather difficult. Thus, we must have an objective understanding of China's coal resource conditions and cannot look solely at our advantages while ignoring our disadvantages. Like our precious cultivated land, precious water resources, and so on, we must allow all of society to propagandize and be concerned with protection and conservative utilization of our coal resources.

At present, however, utilization of China's coal resources is not in everyone's mind. This is manifested in the overly-rapid total consumption of our coal resources, excess development and low extent of utilization of coking coal, accelerated degradation and abandonment of mining regions in east China, and many other things. China's total coal output in 1990 was 1.08 billion tons, which consumed roughly 4 billion tons of our reserves.

Recovery rates in mineshafts in unified distribution coal mines are about 50 to 60 percent, but the recovery rates in township and town coal mines and some local state-run coal mines in regions with abundant resources are only about 10 to 15 percent or even lower, so there is serious destruction and waste of resources. Coking coal accounts for less than 30 percent of our total available reserves while output of coking coal accounts for 50 percent of China's total output, and only one-third of it is washed. A large amount of coking coal is burned up as regular fuel, which is extremely regrettable. Premier Zhou Enlai criticized indiscriminate cutting of forests while he was alive. He said that this was eating the food of our ancestors and a sin against our descendants. These, however, are actually renewable resources, while coal is non-renewable, so it requires us to be even more vigilant. Because of the highly intense extraction in mining regions of east China, the depth of extraction has continually increased and the "three downwards" have more compressed coal, severe threats from karst water, and extreme shortages of successor mining regions and mineshafts. There are 20 mining regions in east China that are expected to be abandoned before the year 2020. Thus, to maintain a longer lifespan in mining regions of east China, we must build new mines, control extraction to a reasonable intensity, and shift the strategic focus on our coal industry toward west China. Transportation problems, however, have slowed the shift of our strategic focus.

Coal resource management at the present time is also a serious problem. Although the state has already promulgated the "Mineral Resource Law", there are still quite a few phenomena of disobedience of the law. Over the past several years, there has been surging growth of township and town collective coal mines and their output now accounts for one-third of output in China. This has played a major role in alleviating our coal shortages and bringing prosperity to local peasants. Several small pits mine marginal blocks and sections that have been discarded by state-run mines as well as off-the-record reserves and waste coal, which has played a definite active role in recovering and utilizing resources. However, the surging growth of collective and individual coal mines has been accompanied by a widespread loss of control in management. Large numbers of small coal mines are mining without permits and are unconcerned with science. They use primitive and backward mining methods for indiscriminate extraction, which not only wastes the state's resources but also provides no guarantees for safe production, so one could say that the price they are paying is too great. The issue at present is to carry out rectification of township and town collective and individual coal mines and guide them toward healthy development. Investments to build state-run mines were made according to unified state plans and the state has approved a full complement of all types of procedures and documents. Even today, however, a substantial number of unified distribution coal mines lack or have not received mining permits. Statistics show that there are 622 units within the scope of unified

distribution coal mines that should be issued permits, but 201 have not been issued permits, equal to about one-third. This means that most of those mining regions that have received mining permits still have not received legal protection for resources and safety. Surveys show that over one-half of the resources in mineshafts in unified distribution coal mines in China have been taken over and damaged by small coal pits, seriously threatening safety in unified distribution coal mines. This violates the provisions in the "Mineral Resource Law". We feel deeply that it is essential that we start with the characteristics of coal resource excavation and reinforce management in the coal industry.

Ensuring sustained and stable development of the coal industry requires continual expansion of coal production capacity and construction of new mines and mining regions. The first work to be done here is to strengthen investments in geological exploration, increase the carefully surveyed reserves that can be provided for new mine construction, and increase the extent of guarantees for new mine construction from carefully surveyed coal reserves. In the Seventh 5-Year Plan, for example, 806 operating drill rigs in 1985 completed 1.94 million meters of exploratory drilling work while 515 drilling rigs operating in 1990 completed 900,000 meters of exploratory drilling work. Capital construction expenditures fell from 68.88 million yuan in 1985 to 31.1 million yuan in 1990, making it impossible to replace outdated equipment. At present, coal field geological prospecting work is quite unable to adapt to coal industry construction. It was mentioned previously that we have only 95 billion tons of carefully surveyed reserves, but after deducting the reserves taken over by local small coal pits, the reserves that require supplementary prospecting, and existing mines included for expansion and extended depths, we have only 36 billion tons of carefully surveyed reserves that can be provided for building mines. During the Eighth 5-Year Plan, the scale of construction starts for new mines planned for our unified distribution coal mines is 180 million tons, but this includes mine reserves of one-fourth the scale that have not been implemented. Only one-third of the mines where construction is to begin during the Ninth 5-Year Plan now have detailed geological survey reports, the others being in the sample survey, survey, or even coal prospecting stages, so the degree of guarantees is extremely low. If we wish to do an average of 1.91 million meters of exploration projects each year from 1991 to 1997, this will require 1.15 billion yuan in prospecting activity funds but we now have only 500 million yuan each year. Because of problems in the area of the management system in local coal mines, the state can only provide geological survey reports. To attain the detailed survey reserves required for mine construction, we will have to invest in 4 times as many prospecting projects compared to the extent for surveys. Because local coal mines in many provinces (autonomous regions) are finding it difficult to raise and borrow capital for exploration, mine investments have been reduced and there are no guarantees for geological prospecting funds.

In summary, the current situation for China's coal resources tells us that we must treasure our resources, manage our resources properly, and strengthen resource exploration before we will be able to guarantee the requirements of future development.

Effective, Rational Use of Coal Resources

926B0085B Beijing ZHONGGUO NENGYUAN
[ENERGY OF CHINA] in Chinese No 4, 25 Apr 92
pp 28-29

[Article by Wang Zhuokun [3769 0587 2492] of the Ministry of Energy Resources Energy Conservation Department: "Rational and Effective Use of Coal Resources"]

[Text] Effective utilization of coal resources is a major strategic question in China's sustained social and economic development. China is the world's leader in raw coal output, but in a situation of low per capita available reserves and consumption levels, we are consuming our resources too quickly. One reason is waste in extraction and a second is low utilization rates. Present coal recovery rates are low. The recovery rate in unified distribution coal mines is generally 50 to 60 percent. The rate is 30 to 40 percent in local state-run coal mines and only 10 to 20 percent in township and town collective mines. Moreover, this has destroyed the resources of large nearby mines and mining regions planned by the state. In the area of utilization, the effective utilization rate of the coal that is mined averages only a little more than 20 percent. Rational extraction and effective utilization of coal are problems that demand solutions.

I. Do Good Coal Dressing and Processing

Dressing and processing of coal should be an important part of the coal industry and is the most effective way to improve coal quality, increase product varieties, rationally utilize resources, conserve energy resources, improve the safety and economy of coal-fired furnaces and kilns, reduce ineffective transportation, and reduce environmental pollution from burning coal. The industrially developed countries wash almost all of their raw coal, but the washing rate in China is just 18 percent. With increases in the extent of mechanization of coal mining, there will be corresponding increases in the gangue and ash content of raw coal, so dressing raw coal is obviously even more important.

At present, power coal and coal used in industrial furnaces and kilns consume about 80 percent of our total coal output and most of it is burned as raw coal, which is obviously not rational. For the coal used at power plants, for example, the average ash content at present is 28 percent, double the usual amount in foreign countries. Our power plants burned 310 million tons of coal in 1991 that contained 86.8 million tons of ash. Reducing the ash content by 10 percent would reduce useless transport by 31 million tons a year and coal consumption in power plants could be reduced by at least 3

g/kWh, power plant safety would be improved, and there would be reductions in equipment maintenance time, operating costs, and power generation costs. It would also reduce pollution of the environment. For coal enterprises themselves, increasing the amount of raw coal that is washed could increase their incomes by more than 10 yuan per ton of coal and could reduce coal mine losses. Building gangue (heat) power plants and employing circulating fluidized bed combustion technology to use washed gangue and coal slurry as fuel would allow the use of poor quality coal and still reduce environmental pollution. In the future, the amount of coal used in thermal power plants each year will increase more than 20 million tons and we must improve the thermal efficiency of industrial boilers and kilns and reduce pollution, so washing and processing raw coal is an inevitable trend.

A. Increase the proportion of coal that is dressed and processed

When the state is formulating programs and assigning plans, besides raw coal indices, there should also be indices and investments for processing coal. In the future, when arranging mine construction, coal washing plants with a corresponding capacity should be built for coking coal and coal washing or coal dressing plants should be built for other types of coal. There are great variations in the quality of coal from local coal mines, so there is an even greater need to increase investments in this area to add to the dressing capacity. Investments to build coal washing plants should be increased from the present level of about 5 percent of coal mine investments to more than 10 percent. Washing of all coal shipped out of provinces that involves raw coal with an ash content in excess of 20 percent should be achieved during the Eighth 5-Year Plan.

B. Make rational readjustments in coal prices and parity prices for processed coal

The price of raw coal in China at present is too low, which does not help in coal conservation. The parity prices for different product varieties are also unreasonable. For example, the parity price for powdered coal is 103 percent and the parity price for block coal is 106 percent, both of which are too small. This has affected initiative for dressing raw coal and readjustments should be made to achieve an appropriate increase in the parity price for superior quality low-ash coal.

C. Formulate rational coal use policies

First of all, we should prohibit direct utilization of raw coal and poor quality coal in large and medium-sized cities and formulate several compulsory management methods and stipulations to spur all users to utilize dressed and processed coal and processed shaped coal to increase efficiency and reduce environmental pollution.

II. Rectify Local Coke Production

The State Council and relevant departments have put several explicit restrictions on local coke production during the past several years but its output and proportions have increased every year. In 1982, total output of local coke was 6.455 million tons and it accounted for 16.1 percent of total coke output. These figures had risen to 20.86 million tons and 28.5 percent by 1990.

Many regions and units have made temporary local economic interests their starting points and failed to give consideration to comprehensive utilization of resources and environmental protection. They have continued with and even expanded local coke production. This must be rectified and local coal output must be restricted to reduce the proportion of local coke.

A. Restrict production, shut down, or upgrade local coke ovens

Prohibit the manufacture of local coke oven equipment and seek economic and legal responsibility for manufacturers, those who approve such projects, and those who make loans. Basically shut down or carry out technical upgrading in existing local coke ovens over the next 5 years. Two routes can be adopted for technical upgrading. One is transitional oven models using Pingxiang ovens, Luliang ovens, XY-type ovens, and improved ovens from the Seventh 5-Year Plan. The second is replacement with small mechanical ovens, as represented by Model 66, Model 70, and Hongqi No 3 ovens.

B. Increase capital to upgrade local coke ovens

Establish special local coke construction funds whose capital channels can be composed of these sources: 1) Increase fixed assets depreciation rates for local coke equipment; 2) Increase the selling price per ton of coke by 2 to 3 yuan for accelerated upgrading funds; 3) Set aside 1 to 2 yuan per ton from profits from coke sales as a new technology development fund; 4) Use over 80 percent of local coke equipment replacement and upgrading funds; 5) Capital raised by enterprises themselves and capital raised by users; 6) Technical upgrading loans.

The special funds should be controlled by province-level professional administrative departments and bureaus for centralized utilization. The special funds should be allocated as loans according to projects and projects that are handled well can be given appropriate reductions or exemptions from interest or even part of the principal.

C. Increase investments in large machine-made coke and improve quality

Investments in large machine-made coke projects should be increased. Additional improvements are needed at present in machine-made coke equipment. Reinforce management and technical upgrading to increase the

average yearly efficiency from the present 20 tons/manshift to more than 30 tons/manshift by the end of the Eighth 5-Year Plan.

D. Organize a National Local Coke Upgrading Coordination and Leadership Group

With the State Planning Commission and State Council Production Office leading the way, establish a "National Local Coke Upgrading Coordination and Leadership Group" with participation by financial, energy resource, metallurgical, and other departments to assume responsibility for drafting the relevant policy order documents, formulating programs, coordinating relationships, and inspecting, supervising, and urging plan implementation.

Work to upgrade local coke can begin in Shanxi Province, which accounts for about one-half of local coke output, as a focus for breakthroughs.

III. Adopt High Efficiency Coal Combustion Technology and Equipment

Over 80 percent of the coal consumed in China is burned up as fuel. In 1990, thermal power plants consumed 290 million tons of coal, equal to 27 percent of our coal output. Industrial boilers consumed 330 million tons, equal to 31 percent. Industrial ovens and kilns and civilian uses consumed 310 million tons of coal, equal to 29 percent. Coal utilization rates in all three of these areas are rather low, so we must adopt high efficiency technology and equipment for further upgrading.

A. Thermal power plants should adopt high parameter large capacity power generating units

Average coal consumption to generate electricity in thermal power plants in 1990 was 427 g/kWh, so we burned an additional 60 million tons of standard coal a year compared to the industrially developed countries. The installed generating capacity and power output of thermal power plants must be doubled by the year 2000. At existing coal consumption levels, this will require consumption of an additional 120 million tons of standard coal each year, so obviously there is a need to make substantial reductions in coal consumption.

First, upgrading of our nearly 20,000MW of moderate and low pressure and low efficiency generators should mainly involve "replacing small units with large units". If we can complete upgrading of 5,500MW during the Eighth 5-Year Plan, we can conserve 430,000 tons of standard coal each year.

Second, perfect upgrading of our 36,370MW (equal to 36 percent of our thermal power capacity) of Chinese-made 125, 200, and 300MW generators to reduce coal consumption. This should include reducing coal consumption of 200MW generators after upgrading by 20 g/kWh. This item alone could conserve about 2.2 million tons of standard coal each year.

New installation of power generating units should mainly involve imported 300 and 600MW generators to reduce coal consumption for power supplies to 330 g/kWh.

To complete these tasks, besides increases in the corresponding capital construction investments, there will also have to be increases in the relevant capital for "replacing small units with large ones" and for technical upgrading of high consumption generators. "Replacing small units with large ones" should account for a substantial portion of technical upgrading in China. We should increase depreciation rates for power generation equipment, repay loans according to economic results on the basis of projects, and establish an electric power new technology and new products development fund by making deductions of 1 percent from the amount of power sold.

B. Upgrade low efficiency industrial boilers

Only 50 to 60 percent of our 400,000 existing industrial boilers have low parameters, small capacity, and regular

thermal efficiency. Developing heat and power cogeneration in regions with concentrated heat loads could increase thermal efficiency by more than 29 percent. Steam boilers with capacities larger than 20 tons/hour should be fitted with back-pressure type power generators and the new steam used to generate electricity, with the steam discharged by the back-pressure generators being resupplied for industrial uses. Coal mining regions can use coal gangue and coal slurry to build gangue power plants, adopt circulating fluidized bed combustion technology, and achieve heat and power cogeneration.

C. Change industrial kilns and ovens and the structure of civilian fuels

On the basis of adopting energy-saving industrial kilns and ovens and civilian stoves, implement "three fixed" supplies for fixed coal varieties, fixed coal shapes, and fixed coal quality. The coal used for civilian purposes in cities should gradually be replaced with coal gas and coal mining regions should strive to increase extraction and utilization of mine gas.

High Technology Creates Opportunity for Petroleum Development

926B0087 Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 2 May 92 p 4

[Article by Liang Yibin [2733 3085 3453] and Li Hongtai [2621 3163 3141]: "High Technology Creates New Opportunities for Petroleum Development—A Visit With China Petroleum and Natural Gas Corporation Chief Engineer Li Yugeng [2621 5713 1649]"]

[Text] Over 100 years ago, when the first industrial oil flow of the modern era erupted from a well being drilled in Pennsylvania in the United States, new vitality was injected into the world economy by this inexpensive and high heat value energy resource. Today, although petroleum has fallen from a peak of accounting for 47 percent of the world's energy resources in 1973 to 37 percent in 1989, its status as the head of the energy resource family has not wavered. This is especially true after the 1970's, when high S&T as indicated by computers entered the petroleum industry and created new opportunities for petroleum exploitation.

Not long ago, the International Petroleum Engineering Conference and International Petroleum Equipment Fair were held in Beijing. We visited at the fair with petroleum expert and China Petroleum and Natural Gas Corporation chief engineer Li Yugeng.

Li Yugeng has been involved in leadership work at Daqing Oil Field and now has overall technical responsibility on the petroleum extraction battlefield. He has always been closely concerned with petroleum S&T development trends in China and foreign countries.

Chief engineer Li told us that petroleum development requires complex systems engineering that involves many links from finding resources to extracting oil and gas, including geological surveys, drilling, logging, exploratory drilling, and oil and gas collection and transportation. Over the past several decades, many new and high technologies have moved into the petroleum field and greatly spurred progress toward high efficiency, energy conservation, and automation in petroleum extraction.

For example, after the appearance of three-dimensional digital seismic technology, mankind gained a more accurate three-dimensional concept of geological conditions, which effectively increased the success rate of exploration. Over the past several years, all countries have adopted digital seismic technology for exploration on an area covering 16,000 square kilometers each year, and China has become a "world power in three-dimensional seismic technology", doing work covering as much as 6,000 square kilometers a year.

As the Earth's oil fields in shallow strata, with good extraction conditions, and covering large areas have been developed, people have been forced to shift their sights toward oil and gas resources involving small

reserves and complex geological conditions. As a result, it is difficult for simple traditional exploration measures to qualify and they are gradually being replaced by comprehensive and advanced survey measures. The coordinated use of satellite remote sensing technology, all sorts of geophysical prospecting technology, geochemical technology, nuclear isotope technology, man-machine interpretation systems, and so on have also enabled extraction of resources that are concealed at great depths and well-hidden. The United States, Brazil, and other countries have employed satellite remote sensing in the past several years to discover new oil fields. In the 1950's petroleum workers in China used conventional exploration technology to search for petroleum and natural gas in Tarim, Turpan, northern Shaanxi, and other areas, all without major discoveries. By using digital seismology and other advanced comprehensive measures and technologies during the past several years, major oil and gas fields have been discovered in Tarim and Turpan Basins and a big gas field covering a large area of low permeability was found in northern Shaanxi.

Chief engineer Li said that modern computer technology has also been applied in drilling, logging, oil extraction, communications, management, and other areas. The Texaco Corporation in the United States uses computers for production control, which has increased their oil output by 4 percent and reduced energy use by 20 percent and costs by 30 percent. The computers now used in the petroleum industry are becoming more numerous and larger. China's biggest domestically produced computer at present, the Yinhe 100MB, serves the petroleum exploration system.

High and new technology have also distinguished themselves in the fields of drilling and petroleum extraction. One type of cluster wells can operate several drills in a single well mouth similar to a bunch of bananas. The results of one well drilled in Canada were equivalent to 24 common wells. The hottest item at present is a type of horizontal well that can bend underground and drill horizontally. It is extremely fascinating for low-output oil fields, thin oil strata, and high viscosity oil fields, with a 2 to 5-fold increase in efficiency. At present, the world as a whole is drilling over 1,000 horizontal wells a year and China's Daqing, Shengli, and other oil fields have gained a grasp of this technology.

Underground nuclear detonations to extract oil is a new technology with extremely good prospects and the United States, Soviet Union, and France are testing this method. Nuclear detonations can create large numbers of fractures in strata and facilitate permeation by oil and increase oil extraction rates. In addition, extraction and location of oil via microorganisms, nuclear radiation logging, and so on have developed rather quickly.

Chief engineer Li feels that many aspects of China's petroleum exploration and extraction have attained international levels of the 1980's and that we have also

distinguished ourselves in continental facies oil generation and accumulation theory, three-dimensional seismology, computers and man-machine interpretation systems, early period water injection, and other fields that have attracted the attention of international petroleum circles. However, the oil fields of eastern China have been extracting for a long time and they have inadequate reserves and substantial increases in costs that now constitute a serious challenge to China's petroleum industry. For this reason, extending new and high technology and greatly reducing energy consumption are important topics facing technical personnel in the petroleum industry.

Chief engineer Li said that the gratifying thing is that China has developed several types of highly efficient and energy-saving petroleum equipment in the past several years. Numerical control power source traction rare earth electric motors, for example, can conserve power by 40 percent. The performance of the permanent magnets in these rare earth electric motors can be preserved for 8 years without attenuation. New numerical control electric traction systems will provide a generation of highly efficient and energy-saving equipment for the petroleum battlefield. Other things like numerical control oil pumps, numerical control multipurpose submersible water pumps, and so on are patented technologies and have attained international levels. They attracted broad attention from Chinese and foreign colleagues at this International Petroleum Engineering Conference.

Looking toward the future, chief engineer Li has full confidence in China's petroleum industry. He said that we have already grasped 10 billion tons of petroleum reserves and have attained a yearly output level of more than 130 million tons. In the 1990's, we will adhere to the strategic deployment of "stabilizing east China, developing west China", make a major effort at developing and adopting new and high technology, and try to combine stable growth of China's petroleum industry with achieving high efficiency, energy conservation, and reduced consumption.

Latest Technologies Used To Extract Oil in Old Yumen Fields

926B0093A Lanzhou GANSU RIBAO in Chinese
11 May 92 p 2

[Article by reporter Wang Fuhai [3769 1381 3189]]

[Text] By following and vigorously applying S&T advancements, the Yumen Petroleum Administrative Bureau has revived steady output from old oil fields, and has developed new oil fields in the Turpan-Hami Basin.

After a half-century of change, the Yumen Petroleum Administrative Bureau has reached the saturation point in well placement and is now in a period of diminishing daily output of crude oil. To counteract this trend, the Bureau has looked to S&T to revitalize oil. At the Laojunmiao, Yaerxia, Baiyanghe, and Shiyougou wells

in the old oil fields, research into full-scale deep-well drilling, oil-water well monitoring, and oil well chemical agents was begun, and employment of foreign and domestic advancements in magnetization technology, sonic processing to increase oil strata yields, acid fracturing technology, and oil well paraffin removal and prevention technology was expanded, with the result that degradation was effectively reversed, enabling the oil field to guarantee developmental targets at advanced levels, assuring many years of steady output. Last year, the Bureau used shallow-well high-pressure gas fracturing technology at 23 wells achieving over 90 percent effectiveness, and increased output of crude oil by over 2,700 metric tons. The Xinjiang Turpan-Hami oil fields, in conducting two natural resource evaluations requested by the China Oil and Natural Gas Corporation, used water injection and well placement to good effect, and made major refinements in water injection methods and water injection pressure systems testing. Last year, the Bureau started and completed 58 S&T projects, earned a profit of 21.8722 million yuan, and increased crude oil output by 15,507 tons.

State Council Approves 1-Billion Yuan Coal Gasification Project

926B0088B Shanghai JIEFANG RIBAO in Chinese
18 Apr 92 p 1

[Article by reporter Shen Jixin [3088 0679 9515]: "State Council Approves Investment of 1 Billion Yuan To Start Construction of 'Three Integrated Supplies' Coal Gasification Project, Shanghai Coking Complex Held Mobilization Meeting On 28 April 1992"]

[Text] Construction has gotten fully underway on a major project in Shanghai during the Eighth 5-Year Plan approved by the State Council at an investment of 1 billion yuan, the Shanghai Central Coking Complex's "three integrated supplies" coal gasification project, and a mobilization meeting was held on 28 April 1992.

The "three integrated supplies" is China's first set of imported advanced technologies. They will use direct gasification of coal as a tap while also producing coal gas and chemical industry products, and use heat to generate electricity in an integrated systems engineering project. After the whole project goes into operation, it will use about 700,000 tons of coal each year and can produce 1.7 million cubic meters of urban coal gas each day. In addition, it can also produce 200,000 tons of methanol each year. Construction is planned for completion at the end of 1994. Its coal gas can provide 400,000 to 500,000 households with coal gas via pipeline.

Crude Production at Changqing Topped 1.55 Million Tons in 1991

926B0080B Lanzhou GANSU RIBAO in Chinese
24 Mar 92 p 1

[Article by reporter Zhou Fengzhen [0719 1144 4176]]

[Text] The Changqing Oil Field Prospecting Bureau has relied on science and the promotion of new technologies, worked to excavate deeper to revitalize old oil fields, steadily developed new production areas, and has won bountiful results. Last year, its production of crude oil was 1.555 metric tons, which was 103.7 percent of the planned output, the highest level achieved since the founding of the oil field.

The Changqing Oil Field Prospecting Bureau's purview extends over Shaanxi, Gansu, Ningxia, and Nei Mongol, a prospecting area of 370,000 square kilometers, one of the largest petroleum bases in China. In the past year, in an effort to maintain steady growth in production of crude oil, the Bureau stressed S&T advancement, S&T management, wide application of new processes and 58 new technologies, and brought low-permeation technology for oil fields up to new levels of development. Especially in the application of eight new full-scale technologies at Anse oil field, and the comprehensive regulation technologies at Maling oil field, there have been notable successes, such that all 29 economic targets for administration of oil field development were met, 11 of which were of advanced level among comparable industries, and four set new historical records. Deep drilling for revitalization of old oil fields, and development of new oil fields were undertaken simultaneously. Last year the Bureau conducted 3,430 engineering tasks to deepen well shafts, and increased output of crude oil by 61,600 metric tons.

Drilling in Changqing Fields Hits Big Natural Gas Deposit

926B0079A Lanzhou GANSU RIBAO in Chinese
4 Apr 92 p 1

[Article by reporter Zhou Fengzhen [0719 1144 4176]: "High-Output Gas Well Drilled at Changqing Oil Field, Daily Natural Gas Output More Than 330,000 Cubic Meters"]

[Text] Following its huge successes in natural gas exploration during 1991, Changqing Petroleum Exploration Bureau recently reported another victory. After 4 days of systematic testing of the work system at the Shaanxi-45 well, a daily natural gas output of 337,500 cubic meters was measured, which is equivalent to more than 700,000 cubic meters of resistance-free flow. This was the first high-output gas well attained on the front line of natural gas exploration by the Changqing Petroleum Exploration Bureau during 1992.

Breakthrough advances have been made in natural gas exploration by Changqing Petroleum Exploration Bureau during the past year, with a success rate of 80 percent, which set the highest record in China. It has proven 86.546 billion cubic meters of natural gas reserves, equal to 78.6 percent of China's total proven natural gas reserves, and its natural gas exploration results are the best in China.

The newly-proven Shaanxi-45 well is located on the boundary between the central and northern parts of a large gas field in the middle of Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia] Basin. This well was drilled by the 3268th Drilling Team, which completed drilling at the end of November 1991. Employees of the 165th Oil Testing Team worked in bitter cold at temperatures below minus 30°C to complete this well ahead of schedule. Projections by experts indicate that there will be a high-output regional block between this well and the Shaan-17 well, Shaan-8 well, Shaan-42 well, and Shaan-44 well. This will provide an excellent foundation for obtaining significant amounts of proven reserves in the northern area during 1992.

New Bohai Oil Should Flow Soon

40100052B Beijing CHINA DAILY (BUSINESS WEEKLY) in English 1 Jun 92 p 4

[Article by Chang Weimin: "New Bohai Oil Should Flow Soon"]

[Text] After opening to foreign oil companies a decade ago, petroleum development in China's Bohai Sea is set to go into full swing soon.

Production in three fields should begin one after another from this year.

One of the fields is expected to go into production in a couple of months.

Officials from the Bohai Oil Corporation said their firm is speeding up construction of the oil fields.

That means oil production capacity in the sea may reach 3 million tons within a few years.

Also, production of 500 million cubic metres of natural gas is expected.

In the sea, three oil fields already exist with total production capacity of 1 million tons of oil a year. Output last year was 950,000 tons of oil.

Bohai Oil Corporation, which has co-operated with eight foreign oil firms, stands ready for more overseas petroleum developers to come, said Li Bingquan, President of the company.

BOC has co-operated for a decade with foreign oil firms in two-thirds of the 5,750-square-kilometre oil-bearing area in the sea.

And in the meantime, the company has conducted self-financed oil exploration and exploitation in the rest of the area.

Li said the efforts by the company to co-operate with foreign firms while at the same time financing its own exploration and production is part of a two-pronged strategy.

"The strategy has proved successful and we'll keep it in the coming years," Li said.

"The situation at present is good and the future is bright," he said.

BOC is a subsidiary of the China National Offshore Oil Corporation (Cnooc) and employs 16,000. It began China's first oil development joint venture with foreign firms in 1980.

Since then, eight firms including the Japanese China Oil Development Corporation and Chengbei Oil Development Corporation, French Societe National Elf-Aquitaine, and American Amoco Orient Petroleum Company have joined in.

Besides, BP Petroleum Development Ltd, Texaco Petroleum Maatsoappij (Holland) B.V. and Australian BHP Petroleum (China) Corporation have also joined hands with BOC.

BOC and the Japanese Chengbei Oil Development Corporation started joint operation of the Chengbei oil field in 1980. Annual oil output there stood above 400,000 tons between 1987 and 1991.

Li said BOC is looking forward to more opportunities to start co-operation with foreign firms in the Bohai Sea where petroleum reserves are promising.

Also, the company plans to speed petroleum exploration and development on its own.

He said his firm discovered an oil deposit early this year and findings show there are good prospects for a high-yielding oil field to emerge.

In-depth appraisals on the deposits are underway now.

Positive results in the drilling of five oil and gas wells have been achieved.

BOC officials said the initial results bode well for the company to finance exploration and development itself.

Sino-Japanese Oil Research in Tarim

40100052C Beijing CHINA DAILY (Economics and Business) in English 2 Jun 92 p 2

[Article: "Sino-Japanese Oil Search in Tarim"]

[Text] Urumqi (Xinhua)—A seismic survey team formed jointly by China and Japan began operations to explore for oil and gas resources on May 23 in the southwestern part of the Tarim Basin.

This marks the first occasion China and Japan have joined forces for oil and gas exploration.

The survey team, consisting of over 200 Chinese and Japanese technicians, plans to complete a seismic survey in the 3,500-square-kilometre Kashi and Yecheng sections of the basin over the next four and a half years.

The Japanese will invest over \$60 million in the project, and the two sides will each send 12 senior technical personnel to participate in the project.

The Tarim Basin, which covers 560,000 square kilometres, is estimated to be China's largest basin containing abundant oil and gas reserves. In 1977, Chinese survey teams discovered an oil and gas field in the southwestern part of the basin.

Prospecting in Tarim Fields Yielding Great Results

926B0091B Urumqi XINJIANG RIBAO in Chinese
12 Apr 92 p 1

[Article by reporters Zhang Lixue [1728 4539 1331], Wang Hongwei [3769 4767 5898], and Hao Guiping [6787 6311 1627]: "Responses Meeting Specifications Submitted from Battle for Petroleum in Tarim, Five Ready Oil Fields Located, Dawn of An Even Larger Area"]

[Text] Substantive advances have been made in petroleum exploration and development in Tarim over the past 3 years. Five ready oil fields have been proven at Longnan, Donghetang, Sangtam, Jirak, and Jiefangzhudong [liberation canal east], and several high-output oil and gas wells have been drilled in the Yingmaili, Tazhong [central Tarim], and other regions. Geological reserves with yearly output of 5 million tons of crude oil have now basically been established and the dawn of developing an even larger area has been seen.

After the establishment of the Tarim Petroleum Exploration and Development Headquarters on 10 April 1989, nearly 20,000 people in 30 seismic teams, 46 drilling teams, and other specialized contractual service teams have collected there and are adhering to the work principle of "two news and two highs" in undertaking a big new petroleum battle in the harsh environment of Tarim Basin. They have made six major achievements in the past 3 years:

1. Industrial oil and gas flows were obtained from 25 exploratory wells in the huge buried hill formation that covers 2,450 square kilometers in the Lunnan region. Four high-output strata systems have been found in the Ordovician, Carboniferous, Triassic, and Jurassic. Two oil fields have been proven in the Lunnan fault-overlap zone and Sangtam fault-overlap zone, and they have basically clarified the oil-bearing characteristics of this region.

2. Two Triassic system anticlinal oil fields have been discovered and proven by completing 11 exploratory wells in the Jirak region, the Jirak anticline and Jiefangchudong anticline. Particularly noteworthy is the high-output oil and gas flow obtained from sandstone at the bottom of the Carboniferous system at the Lunnan-59 well in the eastern part of this region. Seismic horizontal measurements indicate that this sandstone becomes thicker along the bottom and that it has good closure and

capping conditions and may have formed large super-thick oil and gas strata. The achievements made at this well have extremely important strategic significance for developing an even larger area.

3. Over 100 meters of enormously thick marine facies petroliferous sandstone has been drilled in the Donghetang region. They have discovered a rich oil and gas accumulation zone at Donghetang and located the Donghe No 1 and No 4 anticlinal oil and gas strata. In addition, more than 280 meters of enormously thick Devonian bituminous sandstone was discovered at the Ha-1 well, an indication of a new realm for oil exploration.

4. Seven exploratory wells were completed in the Yingmaili region and two oil-bearing structures were discovered. High outputs were also obtained, especially from the Yingmaili-9 well, which produced the first high output oil flow from the Cretaceous system and opened a new front for petroleum exploration in Tarim Basin. It has now been confirmed that this is a large group of structures that may provide substantial reserves and oil-bearing areas.

5. After obtaining a high-output oil and gas flow from the Ordovician system at the Tazhong-1 well, the Tazhong-4 well drilled through four sets of oil-bearing strata systems in the Carboniferous system. Particularly noteworthy is that more than 100 meters of petroliferous sandstone was found at the bottom of the Carboniferous system and its oil-bearing conditions are extremely similar to those at Donghetang oil field, so the oil-bearing scale must be much larger. This encouraging and significant achievement illustrates gratifying prospects for finding large oil fields in the central Tarim region.

6. A basically complete development and production area has been completed in Lunnan oil field and its yearly production capacity has now reached 1 million tons.

These important achievements presage the arrival of an even larger area for exploration and development.

The Tarim Petroleum Exploration and Development Headquarters convened a victory commendation meeting on 10 April 1992 to commend and name 10 surveyor's pole collectives and 10 pacesetters who had made prominent contributions to petroleum exploration and development during the past 3 years. Another 76 advanced collectives and 229 advanced producers (workers) also received commendations.

The China Petroleum and Natural Gas Corporation sent a congratulatory telegram.

Xinjiang Uygur Autonomous Region vice chairman Mao Dehua [3029 1795 5478] attended the meeting to offer his congratulations and give a speech.

Big Potential Seen for Development of Coal-Associated Gas

926B0080A Lanzhou GANSU RIBAO in Chinese
30 Mar 92 p 1

[Article by GANSU RIBAO reporter Yan Ming [0917 2494] and CNA reporter Wang Jianping [3769 0256 1627]]

[Text] Scientists at the CAS Lanzhou Institute of Geology have formulated a new theory of "multi-source composition, multistage continuum" for the formation and evolution of natural gas. Guided by this theory recent scientific findings have shown that China's natural gas resources are rich, and coal-associated gas fields are very promising areas for development of natural gas in China.

In order to develop a theoretical basis for prospecting and developing China's natural gas resources, scientists of the CAS Lanzhou Institute of Geology conducted a 10-year study of China's primary large- and middle-sized oil and gas fields, collected over 3,500 samples of gases, liquids, and solids, completed nearly 30,000 geologic structure and composition tests, and based on the research and analysis of the general characteristics of natural gas formation and specific characteristics of various forms of natural gas, advanced a new theory on the formation and evolution of natural gas. It was demonstrated in their research findings that organic and inorganic processes, or naturally existing organic materials, under certain conditions can form natural gas, and that the search for natural gas is, therefore, not restricted to basins that form petroleum, but extends to coal basins as well. In the course of their research the scientists discovered a hitherto unknown phenomenon: within the sedimentary shell of the earth's mantle, there is helium of sufficient volume to warrant development and exploitation of helium fields for commercial purposes.

Scientists at the Lanzhou Institute of Geology, having unified their analysis of China's geological circumstances, believe that geological conditions for various kinds of large-scale gas fields exist, and coal-associated gas fields will be among the areas of greatest potential. China's Ordos Basin, Junggar Basin, and Turpan-Hami Basin have the best potential for upper-paleozoic and mesozoic coal gas, the East China Sea and South China Sea areas have the best prospects for cenozoic coal gas, and the Songliao Basin has the best potential for gas in the terrestrial-biospheric thermal-transition belt.

Recently, at Lanzhou, the Expert Evaluation Committee, composed of 11 nationally well-known geologists, conducted its evaluation of "The Natural Gas Formation Theory and Its Practical Application", and expressed the view that not only is it of value to natural gas and earth sciences, but it has practical significance for improving natural gas prospecting and development in China.

Work of Lanzhou Geological Institute, CAS, Recapped*926B0093B Yinchuan NINGXIA RIBAO in Chinese 16 Apr 92 p 4*

[Article by CNA Lanzhou]

[Excerpts] The findings of a strategic analysis of the oil and gas resources of the primary depositional basins in western China, a key project of the Seventh 5-Year Plan completed by seven cooperating units including the CAS Lanzhou Institute of Geology, show that western China has a great potential for oil and gas development.

In order to establish an oil and gas prospecting strategy, the CAS Lanzhou Institute of Geology, cooperating with over 50 scientific researchers, applied the latest theories and methods, and found that the nappe belts of basin rims, the pan-shaped depressions in the prominences of the central basins, slopes of major depressions, the paleodomes, and the Kelatong rim depression, have promising oil-bearing characteristics. They then found a previously undefined "massif ocean trough system", thus establishing a new system for evaluating oil and gas resources in the northwest, expanding the scope of oil exploration. [passage omitted]

It is thought that the Jurassic coal component, hydrogen rich vitrinite, found in the various basins of the northwest is best for making hydrocarbons. Its index of oil maturity covers the full range, containing deposits of low-maturity oil and mature oil as well. This theory is beneficial for expanding oil exploration in coal-bearing strata. Their study of diagenesis revealed four processes for the formation of secondary porosity and fissures, including a new idea that reservoir rock of minimum porosity can still form cap rock, and this provides a scientific basis for oil and gas exploration. In view of the above research findings, scientists and technicians are optimistic about setting a strategy for the development of China's oil and gas resources in the northwest.

Petroleum Development Accelerated in Anhui*926B0091A Hefei ANHUI RIBAO in Chinese 25 Apr 92 p 1*

[Article by ANHUI RIBAO reporter Ni Zhimin [0242 1807 2404]: "Department and Provincial Leaders and Experts Form Common Understanding That Petroleum Development in Anhui Province Must Be Accelerated a Bit"]

[Text] "Regarding the question of exploration and development of Anhui's petroleum and natural gas resources, ideology must be liberated a bit and the pace of exploration and development must be accelerated a bit". This was the common understanding formed by leaders and experts in relevant departments of the state and Anhui Province at the Anhui Petroleum Exploration and Development Report Meeting held in Hefei from 21 to 23 April 1992.

This meeting is the first high-level scientific discussion activity since the Anhui Petroleum and Natural Gas Exploration and Development Symposium held jointly by the Anhui Provincial Government and China Petroleum and Natural Gas Corporation in November 1990. The meeting pointed out that new advances have been made in petroleum exploration and development work in Anhui since the 1990 Oil and Gas Exploration and Development Symposium. Three small oil fields have been built in the Tianchang region and industrial oil flows have been discovered in five structures. They have proven more than 4 million tons of geological reserves and formed a yearly production capacity of 40,000 to 50,000 tons. In addition, oil and gas exploration work has gradually gotten underway in new areas in the Anhui-Jiangsu, northern Anhui, northeastern Anhui, and Hefei basins that were discussed at the previous symposium. This phase of work has produced several new understandings and new discoveries of petroleum geology conditions in these regions. Recently, the China Petroleum Development Company and Amoco Orient Petroleum Company in the United States reached agreement on the issue of Chinese-foreign bilateral cooperative exploration and development of petroleum resources in Fuyang Basin. All of these things show that petroleum exploration and development work in Anhui has been picking up and that an excellent start has been made for the Eighth 5-Year Plan.

The meeting determined that the focus to "increase reserves and output" of petroleum in Anhui in the near term is Tianchang and adjacent regions. The state corporation will transfer personnel and equipment and import advanced technology to accelerate petroleum development in eastern Anhui. In addition, the goals of the primary attack will be further clarified in Hefei Basin and the Anhui-Jiangsu region, the amount of preparatory work for oil and gas exploration will be increased, and there will be continued pushing forward with development and utilization experiments for coal seam gas in the Huaibei- Huainan region.

Anhui Petroleum Development 'Not a Dream'*926B0084A Hefei ANHUI RIBAO in Chinese 9 Apr 92 p 1*

[Article by reporter Ni Zhimin [0242 1807 2404] and correspondent Ma Zonggui [7456 1350 6311]]

[Excerpts] [passage omitted] In a conference room in Hanjianzhen, the corporation heads and experts of the well drilling company of the Anhui Petroleum Prospecting Corporation spoke with confidence: there are now three oil fields in eastern Anhui at Wanglongzhuang, Panzhuang, and Ouzhuang, and six other confirmed oil-bearing structures. In 1991, over 40 oil wells at Tianchang oil field produced 32,000 metric tons of crude oil, more than one-fifth more than in the previous year.

Compared with major oil fields, 30,000 tons of crude oil is not much to talk about, but does everyone know the conditions under which the well drilling unit has worked since the first well was drilled in the early 1970s? Petroleum authorities from Beijing have said, compared with any other oil field in China, the geological conditions at Anhui are the worst, and the facilities are the most deficient. Oil extraction facilities in Anhui are judged to be of 1940's vintage, well drilling equipment is 1950's level, and seismic facilities are from the 1960's. Because of lack of funds, oil workers' living conditions are very poor. And so it is that in their efforts to find a major oil field and bring forth high-output wells, the well drilling unit has for more than 20 years set aside personal considerations and worked in obscurity. Without necessary funds for prospecting, they did without rewards and benefits from crude oil revenues and proceeded with drilling. From 1981 to 1991, the corporation actually raised over 40 million yuan for production, and to build up their units they went to Shengli and Jiangxi oil fields to contract labor, raise funds and equip themselves. [passage omitted]

1990 was a memorable year in the history of the Anhui petroleum industry; in November of that year, the Anhui provincial government and the China Petroleum and Natural Gas Corporation convened an Anhui oil and gas prospecting conference at Hefei, and decided to elevate the Anhui Petroleum Prospecting Company to a national main corporation, thus signifying that the Anhui petroleum unit had made history on its own merit.

That raised Anhui's status in national oil and gas prospecting and development business, and in 1991, state-authorized direct investments in Anhui petroleum prospecting and development more than doubled that of the previous year, and units were also dispatched to Anhui to take up prospecting. Daqing, Shengli, and Dagang oil

fields unselfishly gave support in facilities and technology. Last year alone, investments for developmental work in Anhui totalled about half that of the previous 20 years. Petroleum development in Anhui entered a new stage.

At Tianchang oil field, reporters saw many technical cadres and workers who came from the major oil fields. For more than a year after bringing in this talent, wide applications of new oil extraction had begun, such as inclined shaft, water injection, fracturing and blockage-clearing technologies, and there has been a steady influx of new facilities. Once in possession of all that, steady and growing production was assured. Especially satisfying is the fact that in the past year, 15 wells were drilled, and 11 began pumping oil, of which the Tian-shen-45 well became Anhui's first self-flowing high-output well, and the Wang-34 well became the most productive at the oil field. Both have gone into production and they have put Tianchang oil field's daily output over the 100-ton mark.

Anhui's petroleum resources, which rank third among the 10 southern provinces, are out of balance with production mainly because little is yet understood about the geological conditions of the 24 oil and gas bearing basins, which cover an area of 96,000 square kilometers. To correct this imbalance, beginning late last year, the Anhui Petroleum Prospecting Corporation carried out a large-scale seismic data study. A corporation authority, Li Wenyao, personally went to the work site at Qiaotouji in Feidong County to get involved firsthand in the deployment of scientists and technicians to make scientific advancements. The results of the last 4 months are much in evidence. The reporters saw lights on in the S&T building as the scientists and technicians worked into the night. Four well sites have been located, and the work load for the first 3 months of this year is equal to half of last year. [passage omitted]

Is the Qinshan Nuclear Power Plant Safe?

926B0083B Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 22 Apr 92 p 3

[Article by An Sen [1344 2773]]

[Text] Editor's note: Several nuclear power plant leakage accidents have occurred in the world in the past several years that have caused varying degrees of disaster to mankind. People cannot help but ask out of concern, is China's Qinshan Nuclear Power Plant safe? This article provides the answer.

The successful connection to the grid and power generation at Qinshan Nuclear Power Plant ended the history of nuclear technology without nuclear power on the Chinese mainland, and it is an important milestone in the history of nuclear power development in China.

From the beginning, China's development of nuclear power has received a high degree of attention from leaders in the CPC Central Committee and State Council, and they formulated the guiding principle of "safety first, quality first" for nuclear power development. In October 1984, the State Council formally approved the establishment of the National Nuclear Safety Administration for unified supervision and management according to law of the peaceful utilization of nuclear energy and safety matters in nuclear technology throughout China that independently carries out safety monitoring functions. In July 1987, in accordance with the spirit of instructions by State Council premier Li Peng, a technical backup unit for the National Nuclear Safety Administration, the Beijing Nuclear Safety Assessment Center, was established in the Ministry of Nuclear Industry's Second Research and Design Academy. Its task was to conduct nuclear safety assessments of China's civilian nuclear facilities in accordance with nuclear safety regulations and, under the unified leadership of the National Nuclear Safety Administration, to participate in work to inspect and supervise nuclear facilities.

To eliminate as much as possible any hidden dangers that might appear during operation of Qinshan Nuclear Power Plant, the National Nuclear Safety Administration organized over 100 nuclear standard experts from the Beijing Nuclear Safety Assessment Center and related units to conduct a comprehensive and systematic nuclear safety assessment in September 1989 of the "Qinshan Nuclear Power Plant Final Safety Analysis Report" on the basis of a retrospective nuclear safety assessment of Qinshan Nuclear Power Plant.

According to the "People's Republic of China Civilian Nuclear Facility Safety Supervision and Management Regulations" and other nuclear safety laws and regulations that China has promulgated, and in accordance with internationally accepted nuclear safety laws, regulations, and standards, they undertook assessment work in conjunction with actual conditions at Qinshan

Nuclear Power Plant. The assessment work involved strict and conscientious enforcement work. During the final nuclear safety assessment, which lasted for nearly 2 years, the operating unit made some improvements in systems and equipment related to several unsafe factors pointed out in the project by the nuclear safety assessment experts that raised overall nuclear safety levels at Qinshan Nuclear Power Plant.

The nuclear safety assessment experts feel that the safety function design for Qinshan Nuclear Power Plant has the following characteristics:

1. The reactor, the key part of the nuclear island at the nuclear power plant, is a pressurized-water type that is internationally acknowledged as relatively mature and there is substantial international operating experience that can be drawn upon. This is beneficial for guaranteeing safe nuclear operation.
2. To prevent the leakage of radioactive materials to the outside, three screens, the fuel element cladding, primary loop pressure margin, and containment vessel, were installed to provide multiple layers of protection to prevent leaks of radioactivity and conform to the safety principle of deep defenses.
3. Under design benchmark accident operating conditions, to ensure reactor integrity and that the consequences of released radioactivity are held within permissible safety limits, special safety devices were installed, such as a safety injection system, containment vessel spray system, containment vessel isolation system, hydrogen elimination system, containment vessel air purification system, auxiliary feedwater system, and so on. The designs for important reactor protection systems took into consideration multiplicity and diversity, and they satisfy single breakdown criteria.
4. When the main control room is uninhabitable, operating personnel can be immediately evacuated to the emergency control room and still be able to achieve safe reactor shutdown and well as maintain the reactor in a safe shutdown state.
5. Three waste treatment systems were installed to ensure that discharges of radioactive wastes conform to the limits and requirements in international standards (radiation prevention stipulations).

Under normal operating conditions and design benchmark accident operating conditions, Qinshan Nuclear Power Plant, which has the characteristics outlined above, is capable of achieving safe reactor shutdown and removing residual heat from the reactor core to maintain the reactor in a cold reactor shutdown state. Discharges of radioactive materials into the environment conform to the principle of "minimum reasonable amounts". The operation of Qinshan Nuclear Power Plant will not endanger public safety and health and will not harm the environment.

Qinshan Nuclear Power Plant is the first nuclear power plant designed and built by China itself. It will operate strictly according to the limits and regulations stipulated in the "Technical Specifications Document" examined and approved by the National Nuclear Safety Administration. Experience will be accumulated continuously during operation to make management regulations even more strict, perfect quality assurance systems, and improve operating regulations to achieve long-term safe development of China's nuclear power industry.

Specialty Steels for Reactor Pressure Vessels Developed

926B0083A Chengdu SICHUAN RIBAO in Chinese
15 Mar 92 p 2

[Article by Liu Fuxiang [0491 1381 6116], He Xinfu [6320 0207 1133], and Xia Ruqiu [1115 1172 4428]: "Ten Years Attacking Key Problems, Victory Declared In One Day—Special Type of Steel Used For Nuclear Reactor Pressure Vessels Successfully Developed at Deyang"]

[Text] Through the efforts of several 100 S&T workers for 10 years, the steel and associated welding materials for 600MW nuclear power plant reactor pressure vessels were successfully developed recently at Deyang and the task of attacking incisive problems was completed with superior

performance. Evidently, this achievement will be placed into operation at Qinshan Nuclear Power Plant.

Nuclear reactor pressure vessels are one of the key technologies involved in nuclear power plant construction. In 1981, Deyang No 2 Heavy Machinery Plant, China Nuclear Power Research and Design Academy, the Ministry of Metallurgical Industry's Central Iron and Steel Research Academy, Harbin Welding Institute, and other units took joint action to transfer several 100 S&T personnel to Deyang for joint attacks on key problems and completed this system development project that represents our national S&T levels. The low-temperature shock properties of this new material surpass the technical indices stipulated by the United States, France, Germany and other countries more than one-fold and its anti-radiation properties attained the relevant standards and legal requirements of the United States, France, and other countries. Its primary plasticity and malleability indices are also superior to several famous products in foreign countries, which is an indication that China has now become one of the few countries in the world that has this special type of steel.

New Soldering Techniques for Nuclear Reactors

92P60320 Beijing KEJI RIBAO in Chinese 20 May 92 p 1

[Text]



In order to keep pace with the development of China's nuclear industry, the Iron and Steel Institute of the Ministry of Metallurgical Industry has invented new soldering materials and techniques. These materials and techniques were successfully used in the Qinshan nuclear power plant. These new developments have resulted in thin-wall structural component stainless steel alloys of reactor piles that are resistant to rust, alloy corrosion (erosion), and high temperatures. The alloy components have low melting (fusing) points, low resorption characteristics and are resistant to neutron radiation. Shown above are the inventors engaged in vacuum soldering.

Domestic Manufacture of Steam Generators for a 600MW Pressurized Water Reactor

926B0086 Beijing DONGLI GONGCHENG [POWER ENGINEERING] in Chinese Vol 12, No 2, 15 Apr 92 pp 28-32

[Article by Ding Xunshen [0002 6064 1957] of the Nuclear Power Operation Institute: "A Discussion of the Question of Shifting to Domestic Production of 600MW Pressurized-Water Reactor Nuclear Power Plant Steam Generators"]

[Text] Abstract

This article describes the production of our own design and a shift to domestic production, materials, and manufacturing for 600MW pressurized-water reactor [PWR] nuclear power plant steam generators.

Key terms: nuclear power plant, steam generators, shift to domestic production

I. Introduction

A shift to domestic production of steam generators for the 600MW PWR nuclear power plant in the second phase at Qinshan mainly should consider producing our own designs and shifting to domestic materials production and manufacturing. The design for these steam generators mainly take into consideration the blueprint data for the model 55/19B vertical U-shaped tube natural circulation steam generators at Daya Bay Nuclear Power Plant, but it also absorbs practice and experience in the design and manufacture of the steam generators for the 300MW PWR nuclear power plant for the first phase at Qinshan.

II. The Question of Producing Our Own Design

The design for the steam generators should be done by the design academy that is responsible for the design task, be based on the requirements of the overall design and system design, provide equipment technical specifications documents, and be carried out in accordance with the technical specifications documents. Preparation of the design is done mainly according to the standards for nuclear vessel equipment and is responsible for the thermodynamic and hydraulic design, structural design, and steam/water separation functions, ensuring structural integrity under normal operation and transient conditions, and giving full consideration to preventing damage from corrosion of the heat transfer tubes and adopting measures for the heat transfer tube materials and structural design.

A. Standards

Because China has not yet formulated standards for nuclear vessel equipment, the design for the steam generators mainly observes the French standards for the design and manufacture of PWR nuclear island mechanical equipment (RCC-M)^[1]. The components on the primary side of the steam generators fall under grade 1

safety while the components on the secondary side of the steam generators fall under grade 2 safety. The designs for the primary and secondary side components are both done according to grade 1 components. Manufacture and inspection of grade 1 equipment in RCC-M includes all items of manufacturing and inspection work from the insertion of materials up to installation, inspection, and acceptance of the power plant. Its content touches upon RCC-M Volume II, "Materials", Volume III, "Inspection Methods", Volume IV, "Welding", and Volume V, "Manufacturing". It also requires even more detailed industrial standards as a foundation. These standards stipulate concrete requirements for the equipment design, stress computations, materials selection, manufacturing, testing methods, inspection methods, examination and acceptance, cleaning, packaging, transportation, and so on.

B. Structural design^[2]

The structural design should be designed according to analytical methods and do detailed design analysis of the components based on all types of operating conditions and load requirements to satisfy all design standards in the standards. When preparing the structural design, the following characteristics of the structural design of the Framatome Corporation's model 55/19B steam generators must be observed. Among them, the designs for the steam/water separators and dryers are a key question in the steam generator design and are discussed in particular below.

1. Small tube $\phi 19.05 \times 1.09$ mm heat transfer tubes are used to increase the heat transfer area. Tube-end welds and full-thickness mechanical expansion are used to connect the tubes to the tubesheets and mechanical microexpansion is carried out one time in the transitional section.

2. The flow rate distribution plate is located at a position 500 mm above the tubesheets and is 19 mm thick and has a large benched hole in the center. Two L-shaped contaminant discharge tubes are installed on the upper surface of the tubesheets. Two-thirds of the hole is below the center hole for maximum discharge of sludge from the center of the tubesheets.

3. The tube bundle support plate is a linear contact four-blade hole type, the plate thickness is 30 mm, and several segmented supporting draw bars are used to fix it to the tubesheet in a horizontal orientation.

4. After entering the steam generators, the feedwater tubes are linked directly to the feedwater distribution annulus and inverted J-shaped small Inconel 600 tubes are installed on the feedwater distribution loop tubes, with 80 percent of the feedwater entering the hot side of the tube bundles and 20 percent of the feedwater entering the cold side of the tube bundles. In addition, a plate running the full length of the descending side is used to separate the hot and cold sides.

5. The anti-vibration racks on the elbow portion of the tube bundles use square-shaped cross section chrome-plated Inconel 600 anti-vibration bars and the ends of the anti-vibration bars are linked with plate bars to make one unit. The 20-plus anti-vibration bars on the discharge tubes are connected to the tubes with draw hooks.

C. Design of the steam/water separators and dryers^[3]

The design of the steam/water separators must ensure that the humidity of the steam at the outlets of the steam generators is lower than the stipulated humidity (0.25 percent). Usually, cold and hot state performance experiments should be conducted for the steam/water separation devices we design ourselves. Because of the dual-phase flow processes within the centrifugal separators and dryers, accurate mathematical descriptions cannot be made at present, so experimental methods are commonly used for research on steam/water separation in China and foreign countries.

The Framatome Corporation has done a great deal of experimental research on steam/water separators and dryers and they have designed successive new models of highly efficient and compact separators and dryers. The model 55/19B steam/water separators are 16 ϕ 500 mm rotary blade separators and each separator uses two tangential drain outlets and two-stage draining. Four-blade flow-guide helical blades with a rise angle of 30° were designed. The elevation after passing through the blades has a ratio of 3 to the diameter of the ascending tubes. The ratio between the diameter of the chokes and the diameter of the ascending tubes is 0.8. A recovery trough has been added at the outlets of the separators and it is configured with water discharge tubes. The dryers are star-shaped dryers, each layer having a six-sided configuration, one half being a radial wave-shaped plate assembly and one half being a peripheral wave-shaped plate assembly. The results of experiments are that the separation efficiency of the star-shaped dryers is lower than the separation efficiency of dual-layer square dryers. Subsequently, a steam baffle plate was added to the inlets of the star-shaped dryers to enable the steam to flow more horizontally into the wave-shaped plate assemblies. In the model 73/19, they are used in the model N4 1,450MWe and the radial wave-shaped plate assemblies were eliminated, changing the structure to a single-layer configuration six-cornered star-shaped plate assembly. Experimentation is required to determine whether or not the model 55/19B steam/water separators and dryers described previously can be used in 600MW steam generators to ensure steam quality that conforms to specifications.

III. The Question of a Shift to Domestic Production of Materials

A. Materials for the primary parts and components in the Framatome Corporation's model 55/19B steam generators

1. Heat-treated Inconel 690 is used for the heat transfer tube material. On the basis of the mechanical properties

stipulated in RCC-M, it was determined that the optimum annealing temperature is 1,040°C. After annealing and straightening, the tubes undergo stress elimination treatment for 5 hours at 750°C in vacuum conditions.

2. 20 MN 5 M carbon steel castings cast in one piece are used for the lower heads (primary side hemispherical heads).

3. 18 MND 5 is used for the tubesheets. They are low alloy steel forgings equivalent to the SA 508-3 forgings in the United States.

4. The tubes are formed from sheet material and welded. 18 MND 5 low alloy steel sheet is used, equivalent to the SA 533-B sheet in the United States.

5. Z10Cr13 is used for the support plates and flow rate distribution plates. It is 13 percent Cr stainless steel similar to AISI 405 stainless steel in the United States.

B. Heat transfer tube material

The heat transfer tube material for the steam generators used in the 300MW nuclear power plant in the first phase at Qinshan is Incolloy 800 imported from Sandvik in Sweden. The tube dimensions are ϕ 22 X 1.2 mm and they are supplied to the equipment manufacturing plant as U-shaped finished tubes. The tubes underwent 100 percent eddy flow and ultrasonic inspection. Cleanness of the inner and outer surfaces of the finished tube material must be guaranteed and the packaging should be capable of ensuring that they are not deformed during shipment and storage.

The heat transfer tube material for the 600MW steam generators is heat treated Inconel 590. The tube dimensions are ϕ 19.05 X 1.09 mm. To achieve a shift to domestic production of the heat transfer tube materials, the Shanghai No 5 Steel Mill is now carrying out trial manufacture according to the technical conditions of the Framatome Corporation and has invested in building a 6,600 m² plant building. They are now importing five items of special-purpose equipment for producing tubes used for nuclear purposes and special-purpose high-standard steel tubes: dual-belt bright annealing ovens, high-speed cold tube rolling machines, non-destructive flaw detection inspection and testing lines, abrasive belt polishing machines, and endoscopes. If the production schedule for these types of steel tube cannot keep pace with construction of the first set of 600MW nuclear power plants, they will have to import. A shift to domestic production of the heat transfer tubes for the steam generators at the second set of 600MW nuclear power plants is entirely possible.

C. Tubesheets and lower heads

During the process of developing the 300MW nuclear power plant for the first phase at Qinshan, the Shanghai Steel Institute led the development of a type of 18MnMoNb low alloy steel called S 271. Appraisals

show that this type of steel has properties equivalent to A508-3 from the United States. The Shanghai Heavy Machinery Plant used its 200-ton electroslag remelting furnace to smelt over 20 steel ingots weighing over 100 tons for use as forgings for the steam hydropower stations, pressure stabilizers, and other equipment. S 271 steel forgings are used for both the tubesheets and lower heads for the steam generators. The tubesheets are 516 mm thick and have an outer diameter of 3,296 mm. Dual densification measures are used, involving primary densification using WHF (wide hammering-block forcing) and then using the central densification method for secondary densification^[4]. The lower heads have a hemispherical shape with an inner diameter of 3,152 mm and a thickness of 186 mm.

The tubesheets for the 600MW steam generators are 550 mm thick and have an outer diameter of ϕ 3,497 mm. The lower head walls are 145 mm thick and have a thickness of 3,191 mm. Chinese-made ASTM A 508-3 can be used to manufacture the steel forgings for both the tubesheets and lower heads.

D. Tubes

S 271 steel forgings are used for the upper and lower tubes and the conical tubes of the steam generators for the 300MW nuclear power plant in the first phase at Qinshan. Variable cross-section tubes are used to expand the holes in forging the conical tubes to make the shape and dimensions of the forgings approximate those of the finished products^[4].

The upper and lower tubes and the conical tubes for the 600MW steam generators are made by coiling ASTM A 533 B-1 low alloy steel sheet. Because China's heavy machinery plants generally have relatively strong smelting and forging capabilities but relatively weak casting and thick steel sheet rolling capabilities, Chinese-made A 508-3 forgings can be used for the manufacturing. However, the dimensions of the opening of the upper heads exceed the spread of the hydraulic machinery, so new forging and forming methods are required.

E. Support plates and flow rate distribution plates

The material used for the support plates and flow rate distribution plates in the steam generators at the 300MW nuclear power plant in the first phase at Qinshan is AISI 405 stainless steel. The Framatome Corporation supplied and processed the materials.

The support plates for the 600MW steam generators have a circular shape and are 3,086 mm in diameter and 30 mm thick. The material chosen is Z10C13 martensite stainless steel. The flow rate distribution plates are a circular ring-shaped plate 3,086 mm in diameter and 19 mm thick. The material chosen is Z10C13 martensite stainless steel. The Z10C13 martensite stainless steel plate having these dimensions must be manufactured on a trial basis in China. The Shanghai No 3 Steel Mill will begin scientific research and trial development.

IV. The Question of a Shift to Domestic Manufacturing

A. Manufacturing plants for nuclear power plant steam generators

The Shanghai Boiler Plant has already completed a 400 ton-grade heavy vessel workshop. The workshop covers an area of 13,000 m² and is configured with welding, heat treatment, flaw detection, machine processing, assembly, and other production facilities^[5]. They have three numerical control deep boring machines and ϕ 200/ ϕ 300 boring and milling machines with a processing height of 5 m and a diameter of 6.3 m. There is a heavy vertical lathe with a loaded weight of 150 tons, a 30 X 7.5 X 8.5 m heat treatment furnace with a loaded weight of 300 tons, a 100-ton welding positioner, a 400-ton electric-powered rolling rack, and various other types of welding equipment, a 9 MeV linear accelerator with a maximum testing thickness of 400 mm, and an ultrasonic flaw detection and other non-destructive flaw detection equipment. Given its existing conditions and its experience in manufacturing 300MW steam generators, the Shanghai Boiler Plant is entirely capable of manufacturing 600MW steam generators.

The Harbin Boiler Plant has built a new 15,000 m² heavy plant building with a 400 ton hoisting capacity. It has installed 8,000 ton hydraulic machinery, 4 X 4 m and 6 X 8 m narrow-gap submerged-arc welding machines, band pole buttering machines, tube and tubesheet numerical control welders, three-spindle deep boring machines, 5 X 9 m edge milling-planing machines, 4.5 X 32 m coal gas heating furnaces, and other large equipment and key equipment. They imported a 4 MeV linear accelerator, 420 kV X-ray machine, eddy current automatic flaw detector, and other advanced non-destructive testing equipment, and they have imported and added low-frequency fatigue testing machines, electronic drawing machines, and other physical and chemical testing equipment. In 1991 they also imported a three-spindle numerical control deep boring machine, 150-ton positioner, and hydraulic and mechanical tube expansion device from Germany. They purchased a 6.3 m vertical lathe in 1992 and they will build a clean room in 1993. This has given Harbin Boiler Plant the capability of assuming responsibility for manufacturing nuclear power plant steam generators.

B. Tubesheet processing

The tubesheets for the 300MW nuclear power plant steam generators have a 9 mm nickel-based buttering layer and a total thickness of 525 mm. There are 5,954 tube holes on the tubesheets. The tube holes have a diameter of ϕ 22.33^{+/-0.08} mm. The tube holes are arranged in square arrays with a pitch of 31 mm. The tolerance for the pitch between two adjacent tube holes is +/-0.15 mm on the primary side and +/-0.3 mm on the secondary side. The arbitrary tolerance for the spacing between two adjacent tube holes is +/-0.3 mm on the primary side and +/-0.5 mm on the secondary side. The Shanghai Boiler Plant processed the first tubesheet on a

Chinese-made single-spindle deep boring machine and subsequently completed processing tasks for the second tubesheet without problems on a three-spindle numerical control deep boring machine imported from Germany^[6].

The tubesheets for the 600MW nuclear power plant steam hydropower stations have an 8 mm nickel-based buttering layer and a total thickness of 558 mm. There are 8,948 tube holes on the tubesheets. The tube holes have a diameter of $\phi 19.4^{+0.05}$ mm. The tube holes are arranged in square arrays with a pitch of 27.43 mm. The tolerance for the pitch between two adjacent tube holes is ± 0.4 mm for the primary side. The hole bridge requirement on the secondary side is ≥ 6.7 mm. The three-spindle numerical control deep boring machines imported by Shanghai Boiler Plant and Harbin Boiler Plant can satisfy the technical requirements for processing the tubesheets.

C. Support plate processing

The support plates for the model 55/19B steam hydropower stations from Framatome Corporation are 30 mm thick. Two support plates are stacked together and the holes are drilled together by 12 bits. Broaching is carried out on a four-spindle broaching machine, with the four spindles operating at the same time, and a special burr brushing machine is used to remove burrs.

Shanghai has developed and processed three-blade hole-type support plates. The three blade holes undergo electropolishing after broaching and satisfy processing requirements. Thus, processing of the support plates for 600MW steam hydropower stations can be done in China.

D. Welding

In manufacturing 300MW nuclear power plant steam generators, Shanghai Boiler Plant has already gained a grasp of circular seam welding, large tube connection welding, large-area stainless steel and nickel-based alloy buttering, and welding of different types of metals like S 271 steel, nickel-based alloys, stainless steel, and so on. They have gained an understanding of preheating, insulation, dehydrogenization processing, intermediate heat treatment, final heat treatment, and other technologies in the welding process. A computer-controlled tube and tubesheet welding machine imported from Sweden is used for welding of the tubes and tubesheets. The tubes are microshrunk into the buttered layer of the tubesheet holes and positioning and microexpansion of the tube ends are done using a microexpanding tube torsion controller. Packed welding wire tungsten pole inert gas protection welding is used during welding of the inside corners^[5].

All of the welding equipment and techniques described above can be used for welding the 600MW steam generators.

E. Tube expansion

After undergoing helium gas leak inspections of the welding seams on the tubes and tubesheets to determine that they conform to specifications, expansion of the tubes for the 300MW nuclear power plant steam generators is done prior to hydraulic testing of the secondary side. Mechanical rolling expansion is used on a mechanical and hydraulic tube expander imported from Federal Germany. The primary side is expanded first and then the secondary side is expanded. The expansion connection length on the primary side is $50^{+/-2}$ mm at 15 mm from the surface of the primary side of the tubesheets. The expansion connection length of the secondary side is $50^{+/-2}$ mm at $4^{+/-1}$ mm from the surface of the secondary side of the tubesheets.

Tube end welding and full-thickness mechanical expansion is used to connect the tubes and tubesheets for the model 55/19B steam generators. After the full expansion technique is completed, mechanical microexpansion is carried out one time in the transitional region. The actual steps in tube expansion are: positioning expansion, full-thickness expansion, and mechanical microexpansion.

1. Positioning expansion: Control of the amount of expansion and tightening in tube expansion is determined by torque. The tube expansion depth is 10 mm. The depth is guaranteed by ensuring the dimensions of positioning device control for the head of the tube expander. Positioning expansion ensures that the tubes and tubesheets stick together. This is microexpansion.

2. Full-thickness expansion: Full expansion is carried out after helium leak inspection of the tube and tubesheet welding seams. The tube expansion technique mainly involves regulation of the tube expander distance and torque. When the torque exceeds the specified value, the winch crank automatically reverses rotation and moves backward.

3. Mechanical microexpansion: After full-thickness expansion, microexpansion is carried out for the expanded tube bases on the secondary side to create a small amount of radial deformation to smooth out the deformation in the transitional region somewhat, reduce the tensile stress on the tube surface, and improve its ability to resist corrosion.

Different tube expanders are used for positioning expansion, full-thickness expansion, and mechanical microexpansion. The Framatome Corporation feels that using hydraulic tube expansion techniques similarly can satisfy tube expansion requirements.

Because the requirements of the model 55/19B steam generators were used for the tube expansion technical requirements for the 600MW steam generators, there are some differences from the tube expansion technology used for the 300MW steam generators. While the Shanghai Boiler Plant and Harbin Boiler Plant both have

hydraulic and mechanical tube expansion facilities, certain technical experiments will have to be conducted to meet the technical requirements for tube expansion for the 600MW units.

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State Planning Commission Decides To Continue Development of Wind Power

926B0079B Beijing ZHONGGUO KEXUE BAO
[CHINA SCIENCE NEWS] in Chinese 7 Apr 92 p 4

[Article: "The State Will Continue To Develop Wind-Powered Electricity Generation"]

[Text] Recently, the State Planning Commission gave the Ministry of Energy Resources clear instructions regarding the issue of developing wind-powered electricity generation:

1. Take full advantage of China's abundant wind energy resources, continue to develop miniature and small wind-powered electricity generators, solve the electricity supply problems of some frontier regions which lack

electricity. At the same time, relatively large-scale wind-powered generating fields can be developed as appropriate depending on wind energy resource conditions and by adapting to local conditions, to provide supplemental electricity to power grids.

2. Implement the construction of large-scale wind power field resources, do good planning, and gradually implement them.

3. The equipment required for wind-powered electricity generation should make full use of China's scientific research achievements and manufacturing experience and organize forces throughout China to carry out trial development and production. China does not have the capability at present of manufacturing wind-powered generators with unit capacities in the 100 to 250 kW range, so we can use existing cooperation projects with foreign countries to import key manufacturing technology and equipment.

Big Breakthrough Reported in Energy Conservation Technology

926B0079C Beijing RENMIN RIBAO in Chinese
10 Apr 92 p 1

[Article by reporters Cao Zhaoqin [2580 3564 3830] and Ren Zhi [0117 0037]: "Major Breakthrough in Energy Conservation Technology in China, First Large-Scale Circulating Fluidized-Bed Boiler Operates Successfully"]

[Text] A comprehensive energy conservation project, the 75-ton/hour circulating fluidized-bed boiler heat and power cogeneration project at Shengxian County in Zhejiang Province, operated successfully at load on 9 April 1992, attaining a combustion efficiency of 98 percent and a thermal efficiency of 88.46 percent. Its success indicates a new breakthrough in energy conservation technology in China that has major significance for spurring technical upgrading of China's low-efficiency, high energy consumption boilers and promoting comprehensive conservation of energy resources.

Circulating fluidized-bed boilers are the third generation of combustion technology now emerging in the modern world. They are characterized by high efficiency, good desulfurization results, powerful adaptability to coal varieties, ability to improve environmental pollution, and so on. The Shengxian County project is the largest circulating fluidized-bed boiler in China at present.

Apparently, China has one of the world's highest energy consumption levels per unit value of output. China has more than 400,000 industrial boilers with an average thermal efficiency of just 60 to 70 percent.

On 6 April 1992, the Ministry of Materials, State Planning Commission, State Council Production Office, and Chinese Academy of Sciences summarized and exchanged experiences in energy conservation demonstration projects in Shengxian County and called on all relevant departments to actively extend this technical achievement.